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SVIC NOTES

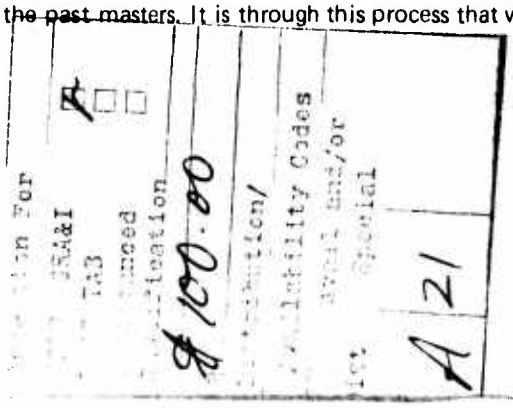
As we pass the midpoint of 1981, it becomes painfully obvious that the cost of the DIGEST must be increased. As of January 1, 1982 the subscription rate will be $140 per year in the United States and $175 foreign. As readers and citizens faced with increasing costs from all directions, you know the reasons. We simply must increase the price to keep the books in balance. My hope is that you will continue to find the DIGEST useful, perhaps even more useful than it has been in the past. Our goal is to provide a focus, a central source for substantially all information related to shock and vibration. As our field becomes more complex, this goal becomes even more important. Not only are we faced with the problem of keeping current investigators up-to-date on technological developments, we must find ways of bringing new scientists and engineers in our community quickly up to speed. The DIGEST will help, but there is more to be done.

All of us who have been faced with shock and vibration problems over the years have our mentors. As with all disciplines, these are the men who broke new ground, the pioneers in the field. In my case, it is such men as Irwin Vigness, Elias Klein, and Charles Crede. But then these men, as young men, must have also had their heroes. Who were they? Could Dr. Charles Crede have looked upon the works of Lord Rayleigh for his guidance? You and I know that it really doesn't matter. The point is that there is wisdom from the past, knowledge to be gained from the experience of others. Looking at the problem of information transfer from this light, perhaps we could perform a service by publishing certain classical articles on a regular basis in the DIGEST. As readers, I would like your opinion on this. Write to me and let me know. It is something we can do if you think it is worth doing.

At the 51st Shock and Vibration Symposium our keynote speaker, Mr. James E. Colvard, said that we must continue to strive for technical excellence. He suggested that a lot of useful information is being and has been produced by technically sophisticated shock and vibration experts. We should share and use this information to our best advantage. We must avoid repeating past mistakes. Indeed, we should capitalize on past successes. On the other hand, another distinguished invited speaker at the last symposium, Henry Caruso, asked a penetrating question, "What are we doing from habit or tradition that's a waste of time and money?" He was referring to some of the sacred cows that seem to blind us to new or better ways of approaching problems. We must therefore not have our creativity fettered by tradition.

It is clear that we can profit from the past, though we are not necessarily controlled by the past. We must be aware of the break throughs that others have made, yet not be afraid to take a new technical turn should that approach be most profitable. But even the most creative and independent of thinkers can benefit from the accomplishments of the past masters. It is through this process that we continue to make progress.

H.C.P.



EDITORS RATTLE SPACE

DISCIPLINE ORIENTED JOURNALS

It may be conjectured whether we have too many professional engineering societies all competing for members and all striving through an increasing number of journals to capture their share of the market. One may also question whether likewise, there are too many engineering oriented magazines and journals offered by our very prestigious and professional publishing houses. But there is no doubt of the need to curtail this information explosion and to make it possible for the grass-roots engineer to easily and quickly put his hands on the right references to help him do his job.

Perhaps the large number of engineering societies and publishing houses prevents this end being achieved when one considers how difficult and time-consuming it is, in general, if only to browse through the contents pages of all available journals.

Yet shock and vibration are disciplines which go beyond the narrow confines of an individual society's purview. Surely we need a series of publications devoted exclusively to shock and vibration irrespective of the applications concerned. The civil engineer needs to learn from the techniques being used by the aeronautical engineer and vice versa -- the applications are of interest but not, I submit, of primary interest.

This then is a plea to the professional engineering societies in each country to devise a series of joint archival journals based on subject discipline (e.g., vibration, shock, fluids, static structural analysis, etc.) rather than applications to ensure that each is hopefully a more useful publication to their practicing engineers.

D.J.J.

MACHINE TOOL VIBRATION -- A REVIEW

V. Ramamurti* and V. Srinivasan**

Abstract. Analytical and experimental methods for assessing machine tool vibration are summarized, as are methods for dealing with vibration isolation, damping, chatter, and noise.

A physical model for nonlinear vibration during broaching has been developed [1]. It has been shown that the structural response of a cutting machine can be estimated by a deconvolution method [2]. It has also been shown that calculation of the dynamic properties of machines is uncertain due to insufficient knowledge concerning attenuation of the system [3]. Development of a device for damping vibration in work pieces is an improvement over lever operated dampers [4]. The performance of a variable stiffness type dynamic damper intended to increase the cutting performance of machine tools that have a long overhung ram has been reported [5, 6]. Results of cutting tests for vertical lathes and boring machines were presented. For the purpose of increasing the dynamic stiffness of mechanical structures, a servo damper method was proposed [7].

Taylor discussed different methods for measuring frequency response of machine tools [8]. Rivin described general principles of vibration isolation, as well as designs of isolators that comply with criteria for effective isolation [9, 10].

A nonlinear two-degree-of-freedom model of a general machine tool has been treated [11, 12]. The responses in translational and rotational modes under the action of actual random metal cutting force were considered. The principal mode of machine tool vibration has been approximated by vibration modes of a second order linear system [13]. A complex flexibility method has been developed for dynamic analysis [14]. A method that involves both experiment and analysis has been proposed for finding dynamic characteristics [15].

Olsen [16] presented practical suggestions for dealing with machine tool vibration; he used a recently developed multipurpose machine tool. An algorithm for calculating the dynamic characteristics of machine tools spindle assemblies has been proposed [17]. Effects of bearing stiffness were also analyzed. The concept of nonproportional damping was utilized by Inamura and Sita [18]. Industrial experiences and possible reasons for lack of agreement between theory and practice have been discussed [19].

Mellor [20] dealt with forces and power levels in cutting machines. Dangerous vibrations caused by small gear errors have been a subject of investigation [21]. Torsional vibration behavior of machine tools has been investigated [22]. Results of research on machine tool vibrations have been reported [23].

A procedure for analysis and interpretation of modulated vibrations in machine tools was developed and then applied to a milling operation by Racciarini [24, 25]. He showed that the interpretation of Fourier spectra was insufficient for modulated oscillations.

COMPUTER STUDIES

A newly developed computer-aided method for presenting an animated vibration pattern of machine tool structure has been described [26]. Transfer functions have been used for dynamic analysis [27], as has the flexibility method [28]. The response of machine tool panels when subjected to random vibrations has been estimated [29]. As many as 20 modes of vibration of machine tool columns have been examined [30]. Reddy and Rao [31] developed computational capability for optimum design of

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complex machine tool structures. They also estimated the reliability of machine tool structures [32] using the horizontal milling machine. The dimensions of machine tools have been optimized; static aerodynamic parameters were accounted for [33]. Dittrich and Gauchel [34] presented computations of machine vibrations from the minicomputer. An improved cutting force model that would minimize the vibration of face milling cutters has been proposed; a weighted fractional usage method for obtaining optimum blade spacing was applied [36].

Finke and Miessen [37] described the development of the programming system DYNAFIN for the dynamic behavior of machine tools. Other similar work has also been reported [38]. Criteria for optimum design drives for numerical control machine tools have been presented [39].

MILLING MACHINES

The dynamics of drives of vertical milling machines have been reported [40]. A mathematical model for the study of a horizontal milling machine is the subject of a discussion by George [41]. The chatter phenomenon associated with horizontal milling machines has also been described [42]. Stability characteristics for given operating conditions for a milling machine have been given [43]. Witek used the rigid finite element method [44] to determine the dynamics of milling machines. The forced vibrations of grinding machines, including instability, stiffness, and interference between wheel and workpiece, have been studied [45, 46].

MACHINE TOOL CHATTER

Weck and Teripel [47, 48] assessed the chatter behavior of a milling machine, especially the critical depth of cut. The behavior of a ram provided with a quasi-moment damper [49], and self-excited vibrations of grinding caused by the regenerative effect of the workpiece surface [50] have been the subjects of investigations. Srinivasan and Nachtigal [51] introduced the concept of regeneration spectrum to design machine tool chatter control systems.

A scheme for control of chatter based on stochastic process modeling has been developed [52]. A theoretical analysis of regenerative chatter during cylindrical grinding has been reported [53], as have experimental and theoretical findings on suppression of grinding chatter [54]. Analytical and experimental investigations of self-excited chatter on metal cutting have been made [55]. Piegert and Pickert [56] developed process-dependent machine life and chatter characteristics. Gyga [57-59] reported recent findings on machine tool chatter and explained dynamic stability using several practical examples. He proposed a new test method that, particularly in milling, largely eliminates some disadvantages of currently known methods.

A possibility method for avoiding chatter oscillations has been discussed [60]. An apparatus developed to measure the instantaneous frequency of self-excited oscillation has been described [61]. It has been shown [62] that, of all known causes of self-excited vibration, position coupling satisfies all the conditions for pure auto-oscillation. A method for assessing the vibration stability of machine tools has been presented [63]. Lombard and Mirski [64] showed that, based on industrial experience, it is virtually impossible to predict the chatter behavior of machine tools. The stability of grinding machines has been discussed and experimental evidence provided [65, 66]. Agafonov [67] presented results of an experimental investigation of the stability of plano millers.

NOISE STUDIES

Osteigaard [68] explained the difference between three-decibel and five-decibel equivalent sound levels. Hodgson [69] showed that rapid deceleration on impact of the platen in a drop forging machine is an important source of impulsive noise. Noise generated during an upsetting process on a laboratory drop hammer has been measured and predicted from first principles [70]. Grabec and Leskovar [71] showed that it is not practically feasible to use acoustic emission analysis to evaluate the sharpness of a cutting tool. Collacott [72] compared the power spectral density of noise when different machines work together and when they work individually.

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LITERATURE REVIEW: survey and analysis of the Shock and Vibration literature

The monthly Literature Review, a subjective critique and summary of the literature, consists of two to four review articles each month, 3,000 to 4,000 words in length. The purpose of this section is to present a "digest" of literature over a period of three years. Planned by the Technical Editor, this section provides the DIGEST reader with up-to-date insights into current technology in more than 150 topic areas. Review articles inlcude technical information from articles, reports, and unpublished proceedings. Each article also contains a minor tutorial of the technical area under discussion, a survey and evaluation of the new literature, and recommendations. Review articles are written by experts in the shock and vibration field.

This issue of the DIGEST contains an article about the method of R-functions and its application to analysis of vibrations of plates and other structures.

Dr. Waberski of the Silesian Technical University, Gliwice, Poland, has written a paper on the development of the method of R-functions to solve value boundary problems of complex form in mathematical physics. This method also has wide application to analysis of vibrations of plates and other complex structures.

METHOD OF R-FUNCTIONS AND ITS APPLICATION TO ANALYSIS OF VIBRATIONS OF PLATES AND OTHER STRUCTURES

A. Waberski*

Abstract. ***The method of R-functions is a new method to solve value boundary problems of complex form in mathematical physics. This method also has wide application to analysis of vibrations of plates and other complex structures. The development of this method in recent years is presented in this paper.***

THEORETICAL BASES

The method of R-functions was developed some years ago and has extensive applications. In particular it can be used for the numerical solution of boundary value problems represented by partial differential equations in space of complex form. It is then used in conjunction with familiar numerical methods; e.g., variational methods, the method of finite elements, and finite difference methods.

The final part in the process of solving of these problems utilizes the equation of contour area of complex form, called the Rvatschev function. R-functions were introduced in 1967 by V.L. Rvatschev [1]. They are special functions closely associated with logic functions and use multiplicity operations to put together areas of complex form from spaces of simple shapes described by a known inequality.

The logic kernel in these functions switches over the indicies in inequalities describing the complex form areas. The exact definitions of these functions have been published [1, 3, 25]. Such operations as multiplicity and addition then correspond to the logic operations. R-functions are not uniquely defined. The simple formulas of typical R-functions are:

$$\varphi_1 \wedge_\alpha \varphi_2 = \frac{1}{1+\alpha}(\varphi_1+\varphi_2 - \sqrt{\varphi_1^2+\varphi_2^2 - 2\alpha\varphi_1\varphi_2})$$

$$\varphi_1 \vee_\alpha \varphi_2 = \frac{1}{1+\alpha}(\varphi_1+\varphi_2 + \sqrt{\varphi_1^2+\varphi_2^2 - 2\alpha\varphi_1\varphi_2}) \qquad (1)$$

$$-\varphi_1 = -\varphi_1$$

$$-1 < \alpha \leqslant 1$$

The equation of contour of the area of complex form $\omega(x) \geqslant 0$ normalized to a suitable high order can be used to formulate the so-called structure of the solution:

$$re = B(\phi) + \varphi_0 \qquad (2)$$

where φ_0 is a known function, and B is an operator dependent on the form of the boundary conditions; the structure of B is such that, for the free function ϕ, Equation (2) exactly fulfills the boundary conditions. The structure of the solution can be obtained by different methods; however, it is most often obtained by a generalized form of Taylor series around the contour lines of a complex form area with a known equation of contour $\omega(x)$ [1, 3, 25].

The unknown functions ϕ in the structure of the solution are calculated by numerical methods that satisfy the partial differential equation describing the value boundary problem. In the early papers these functions were most often calculated by such classical variational methods as the Ritz method and the Galerkin method. In later papers function ϕ were obtained by such methods as the method of finite

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difference [3], the method of subareas, the method of integral equations of potential theory [5], and recently the method of finite elements [21]. Variations of the method of R-functions have been used to solve many problems of value boundary in mathematical physics. At the Institute of Machine Structures, Ukraina Academy of Science in Kharkov, USSR, a cycle of area programs has been completed for solution with different boundary conditions of the equations:

$$\begin{aligned} \Delta u &= f \\ \Delta\Delta u &= f \end{aligned} \qquad (3)$$

and the equations for eigenvalues:

$$\begin{aligned} \Delta u - \lambda u &= 0 \\ \Delta\Delta u - \lambda u &= 0 \end{aligned} \qquad (4)$$

Many problems of value boundary in mathematical physics have been calculated by these programs. They are as follows:

- deflection and vibration of plates [2, 8-13]
- heat conduction and heat convection [3, 4, 6]
- contact problems of elasticity theory [5]
- hydrodynamics and magnetohydrodynamics [22, 23]
- torsion of bars of complex section [18, 19]
- electrodynamics [24]

In most of this work linear problems were calculated. Nonlinear problems were calculated only in some problems connected with heat transfer [4, 6]; the method of perturbation was used. The method of R-functions has also been used to investigate stochastic nonstationary vibration of plates of complex form [25-27]. Suitable programs for the digital computer are available.

Work has been published on the applications of R-functions to problems in mathematical physics [2], to problems in heat transfer [4, 6], and to problems in elasticity contact theory [5]. One investigation had to do with the application of atomic (spline) functions to the method of R-functions [7].

The development of the R-functions method and its use indicate that, as is true with all other methods, there are both advantages and faults. The association of the method of R-functions and the direct variational method of Ritz has the following advantages:

- semi-analytical form of the solution
- simple rectangular network for numericals integrated in the area of complex form; easy generation of network
- easy construction of base functions for area of complex form

The faults include:

- complicated form of base functions in some cases; differentiation sufficient to the construction of the Ritz matrix is difficult
- global sense of base functions for all areas; in some cases errors in approximate calculation introduce numerical instability in the solution

The process of differentiation should be analytical because errors of approximate calculation would then be omitted. The correct analytical formulas of differentiation can be used repeatedly. These formulas can also be obtained by using a special program on the digital computer. The differentiation of base functions is not difficult if the partial differential equations are of second order and the boundary conditions are simple. The second fault can be eliminated if local base functions such as the method of finite elements or the method of spline functions are introduced. The first work in this direction appeared not long ago [7].

APPLICATIONS

Vibration of plates. The method of R-functions was first applied to problems of deflection and vibration of plates of complex form with different boundary conditions [8-13]. This work has been summarized [2].

The method of R-functions was used with the classical Ritz method. Only free frequencies of plate vibration were obtained. Vibrations of plates for the following cases have been investigated [2]:

- clamped for all edges
- simply supported for all edges
- resilient supported for all edges
- partially clamped edge and partially simply supported edge

- partially clamped edge and partially free edge
- partially clamped edge and partially resilient supported edge

Probabilistic characteristics of plates of complex form excited by non-stationary random processes have been investigated [25-27].

Vibration of other structures. The method of R-functions has not been used to any extent to investigate vibration of structures other than plates. In 1971 the method was used to generate the solution for a cylindrical perforated shell [14]. No numerical implementation was presented. The method of R-functions has also been used to calculate optimal distribution of objects of complex form in areas of complex form [28-30].

SUMMARY

In this paper the genesis and development of the method of R-functions from 1967-1979 was given. The appiication of this method to investigations of the vibration of plates, other structures, and other problems has been presented.

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BOOK REVIEWS

SLUCHAINYE KOLEBANIYA UPRUGIKH SISTEM (RANDOM VIBRATION OF ELASTIC SYSTEMS)

V.V. Bolotin
Nauka, Glavnaya Redaktsiya Fiziko-matematicheskoi Literatury, Moscow, 1978 (In Russian)

The book "Random Vibration of Elastic Systems" summarizes the results of 20 years of study by the eminent Soviet Professor V.V. Bolotin. It contains a very well written, lucid, and systematic amount of random vibrations in eight chapters under the following headings:

Chapter I.	Random Loads Acting on Mechanical Systems
Chapter II.	Methods in the Theory of Random Vibrations
Chapter III.	Random Vibration of Linear Distributed Systems
Chapter IV.	Asymptotic Methods in the Theory of Random Vibration of Distributed Systems
Chapter V.	Parametrically Excited Random Vibration
Chapter VI.	Random Vibration of Nonlinear Systems
Chapter VII.	Reliability and Durability under Random Vibration
Chapter VIII.	Planning of Vibration Measurements on Structures Subjected to Random Vibration

References in the book are, by language: Russian (123), English (58), German (8), and French (1); in addition, a small number of foreign (e.g., non-Soviet) documents translated into Russian are referenced.

An English translation of the book would be a welcome addition to the libraries of English speaking engineers who are concerned with random vibration.

M. Dublin
5940 Glenlea Lane
San Diego, CA 92120

ADVANCES IN RESEARCH ON THE STRENGTH OF METALS

D.M.R. Taplin
Vol. 2B - Fatigue; Pergamon Press, New York, NY 1978; 711 pages; $82.00

Fatigue must be considered in the design of buildings; land, sea, and underwater vehicles; bridges; and equipment. At one time development of an S/N curve for a material was sufficient for fatigue studies. However, the quest for lighter weight structures and other requirements have made fatigue studies more complicated. This volume contains a representative selection of papers presented at the Fourth International Conference on Fatigue. The book is divided into two parts that are concerned with fracture mechanics -- crack initiation, crack propagation, and closure -- and fatigue analysis, including high temperature, environment, and low cycle.

Part III: Fatigue and Its Micromechanisms.
Session 1 contains 10 papers on crack initiation. Included are discussions of dislocation mechanisms, plastic deformation, and fracture in slip bands; crystallographic fatigue growth in aluminum and titanium; and the microstructure of fatigue fracture surfaces. Excellent test information is provided.

Session 2 contains 12 papers in the area of high temperature fatigue. Topics include creep, low cycle fatigue, rupture life, fatigue-crack interaction on low alloy steels plus Cu-Cr alloy, turbine steels, and a number of alloy type steels. Few of the papers could be applied to design.

Session 3 contains eight papers concerning environmental aspects of fatigue.

Session 4 contains 10 papers. Subjects include notch prediction life, macroscopic slag inclusions in steam turbogenerator rotor steels, and fatigue life prediction of fillet welds under both service conditions and low cycle fatigue. Additional papers on prediction methods of welded components would have been helpful.

Part IV: Further Aspects of Fatigue.
Session 1 contains 12 papers concerned with crack propagation and closure. The topics are computer simulation of crack closure, overloads and its effect on crack growth, effect of loading sequence (normal and reversal), effect of stress level on fatigue crack delay procedure, and observation of crack closure phenomena by electron microscopy.

Session 2 subjects include theoretical aspects of damage, probability, and biaxial strength. The papers consider fatigue life prediction, Weibull statistics for biaxial strength, probability of failure, high cycle fatigue of prestrained components, fatigue crack initiation in polycrystalline materials, and reversed biaxial fatigue via plastic strain energy criterion.

Session 3 considers such topics as cracks emanating from fastener holes, effect of residual stress, and fatigue crack growth in various metals other than steel.

Session 4 considers crack propagation morphology. The topics discussed are threshold for fatigue crack growth, mechanisms of fatigue crack growth, crack branching, propagation of multiple ended cracks, growth of a surface flaw, and kinetics of fracture propagation. These are very popular subjects at this time.

In summary, this volume is highly recommended to those concerned with major problems in fatigue.

H. Saunders
General Electric Company
Building 41, Room 319
Schenectady, NY 12345

ANALYSIS AND DESIGN OF SERVO CONTROL SYSTEMS

N. Tominari, K. Seto, and J. Okada
Corona Publishing Co., Ltd., Tokyo, Japan
1979 (In Japanese)

This book contains eight chapters and is a reference guide for engineers involved in designing servo control systems and for university students interested in learning mathematical expressions for complex dynamic systems. The text introduces a new signal flow diagram method for modeling actual dynamic systems and applies it to the analysis and design of servomechanisms. Examples show that the method is easily extended to the field of computer-aided design.

This book covers the basic building blocks required for servo control system design – including an analytical method in servomechanisms, dynamic and static characteristics of servo control components, and the software for digital and analog computers (both classic and modern control theories). Chapter 1 treats fundamental linear control theory, which is still useful for the design of actual servo control systems. Performance criteria and specifications required for the design stage are listed for later use.

The signal flow diagram method is described in Chapter 2. The method joins the transfer matrix method with a conventional signal flow diagram. Examples are given of formulations of the complex mechanical, electronic, and hydraulic networks and of applications of the method to the analysis of actual components.

Chapters 3 and 4 contain the basic concepts of components of servo control systems. In chapter 3 the operating principle and characteristics of error detectors, servo amplifiers, and feedback compensators are described. The design of the servo amplifier using IC operational amplifiers is shown in detail.

Chapter 4 treats powering devices and controlled systems. Principles, constructions, and performance analyses concerning hydraulic actuators and servomotors are described. The outlines of dynamic analyses of mechano-hydraulic and electro-hydraulic servomechanisms are given for the design of total

control systems. Servo valves are widely used in the field of power servomechanisms; e.g., autopilot aircraft system, positioning controls of machine-tools, and vibration testing devices. This chapter also describes the operating principle and dynamic performance of three types of typical servo valves and gives information required to select the stage of the servo valve.

The total control systems are designed in Chapters 5 and 6. In Chapter 5 the design for the compensation of feedback control systems is affected by both the frequency domain technique and the root locus technique. A systematic procedure is also outlined for the design of feedback compensation by the classic design method. In Chapter 6, modern control theories are introduced to system design. Modal control theory and Chang's optimum control theory are applied to the design of the servo control system.

Chapter 7 treats computer-aided design and control in those cases in which direct programming of analog computers is done from signal flow diagrams. Also included is the digital simulation method.

The last chapter describes the total design of the servo control system, in which, for examples, a servo-controlled vibration generator for a vibration testing device and numerical control systems for machine-tools are treated and designed. The techniques and methods described in the first seven chapters are applied.

In summary this is a practical book that will be useful to those concerned with servo control design and the analysis of dynamic problems. The book is well illustrated and contains many examples. I feel that readers can easily understand the method as it is explained and will also find it useful in mechanical vibration applications.

T. Iwatsubo
The Faculty of Engineering
Kobe University
Rokko Nada Kobe, Japan

SHORT COURSES

JULY

12TH ANNUAL INDUSTRIAL PRODUCT NOISE CONTROL INSTITUTE

Dates: July 6-10, 1981
Place: Schenectady, New York
Objective: For engineers, designers, environmental health specialists and managers concerned with noise and vibration control. This course will provide information on the theory, measurement and economics of noise reduction. It will cover the latest information on the nature of sound and noise control, including noise criteria, airborne sound distribution, vibration control, and noise signature analysis. Other topics include how noise is produced by different types of engineering equipment such as compressors, electric motors, fans, valves, and transformers.

Contact: Union College, Graduate Studies and Continuing Education, Wells House - 1 Union Ave., Schenectady, New York 12308 - (518) 370-6288.

6TH ANNUAL APPLIED INSTRUMENTATION AND MEASUREMENTS ENGINEERING

Dates: July 6-10, 1981
Place: Schenectady, New York
Objective: Designed for technicians, engineers and managers involved in the field of instrumentation and measurements. It will present a comprehensive view of the instrumentation system from transducer to readout, including a major emphasis on computer interfacing techniques. Principal topics will include: philosophy of measurements, transducer operating principles and selection criteria, static and dynamic data acquisition systems, occurrence and prevention of noise in measurement systems, data reduction methods, digital techniques, and statistical treatment of data. "Hands-on" lab experience will be offered.

Contact: Union College, Graduate Studies and Continuing Education, Wells House - 1 Union Ave., Schenectady, New York 12308 - (518) 370-6288.

COMPUTER-AIDED DESIGN OF CONTROL SYSTEMS

Dates: July 6-10, 1981
Place: East Lansing, Michigan
Objective: This course presents an introduction to time and frequency domain techniques for the computer-aided design of control systems. Both classical (transfer function) and modern (state variable) methods will be developed and applied, thus bringing participants up to current best practice.

Contact: Dr. Ronald C. Rosenberg, Program Director of the A.H. Case Center for Computer-Aided Design, College of Engineering, Michigan State University, East Lansing, Michigan 48824 - (517) 355-8296.

INSURANCE INDUSTRY SEMINAR

Dates: July 7-9, 1981
Place: Carson City, Nevada
Objective: This course is designed for personnel from the insurance industry or self-insured companies who are responsible for inspection of plants that use large, high-speed rotating machinery. Features in the seminar include: discussion of the economics of machine monitoring and predictive maintenance; presentation of machine types that should be considered, and minimum standards necessary for effective machine protection diagnosis; information and the presentation of catastrophic failure by use of proper maintenance methods and malfunction diagnosis techniques; and survey of state-of-the-art methodology.

Contact: Kathy Fredekind, Bently-Nevada Corporation, P.O. Box 157, Minden, Nevada 89423 - (702) 782-3611, Ext. 224.

RELIABILITY ENGINEERING

Dates: July 13-17, 1981
Place: Chicago, Illinois
Objective: After completing this course, participants should be able to calculate the failure rates of compo-

nents and products; construct their Reliability "Bath-Tub" curves; determine the early, chance, and wear-out reliability of components; and determine from data the parameters of the times-to-failure distributions of components and products analytically and by probability paper plotting for the exponential and Weibull cases. They should also be able to determine equipment time-to-restore distributions, along with the reliability of systems of any complexity, including series, parallel, standby, load-sharing, multimode function and switching; and using Bayesian prediction, the confidence limits on the reliability for the exponential, Weibull, and binomial cases. Finally, participants will be able to determine the maintainability of equipment and the reliability and availability of maintained components, equipment, and systems of many levels of complexity.

Contact: Mr. Stod Cordelyou, Assistant Director, Continuing Engineering Education Program, The George Washington University, Washington, D.C. 20052 - (202) 676-6106, (800) 424-9773, Telex: 64374 (International).

PLANNING A DIGITAL DATA ACQUISITION AND CONTROL COMPUTER SYSTEM

Dates: July 20-23, 1981
Place: Schenectady, New York
Objective: The course covers the interconnection of a multitude of devices from sensors to final control elements with ultimate output of system conditions on the man-machine interface devices; the sensing of temperature, pressure, level, flow, speed, weight, torque, vibration and electrical parameters such as: volts, amps, watts, vars, power factor, frequency and motor load. The flexibility and utilization of data presentation via dynamic, colored graphic and tabular CRT displays, is presented as an optimum man-machine interface. System components/hardware and their interconnection are discussed in depth. Staging, on-site testing and as-built documentation are the final steps in the planning of a digital acquisition and control computer system.

Contact: Union College, Graduate Studies and Continuing Education, Wells House - 1 Union Ave., Schenectady, New York 12308 - (518) 370-6288.

12TH ANNUAL CONFERENCE ON FRACTURE MECHANICS I AND ITS APPLICATION TO FRACTURE CONTROL

Dates: July 20-24, 1981
Place: Schenectady, New York
Objective: Material covered will benefit anyone in an engineering related position who is concerned with the application of fracture mechanics to the prevention of brittle fracture such as pressure vessels for power generation, malleable iron castings, structural steel fabricated frameworks and ASME Pressure Vessel code applications. Included are: engineering approach to component failure; failure analysis of pressure vessels; fracture mechanics based toughness criteria in ASME Pressure Vessel code; examples and case histories of code fracture mechanics applications; elasto-plastic analysis; computer aids for calculating remaining cyclical life; crack initiation and propagation, life prediction, and non-destructive testing methods and capabilities.

Contact: Union College, Graduate Studies and Continuing Education, Wells House - 1 Union Ave., Schenectady, New York 12308 - (518) 370-6288.

RELIABILITY TESTING

Dates: July 20-24, 1981
Place: Chicago, Illinois
Objective: This course has been designed to enable participants to calculate the failure rates of components and products; determine the early, chance, and wearout reliability of components and products; and determine the parameters of distributions involved in the time-to-failure data of components and products analytically and by probability paper plotting; conduct Chi-Squared and Kolmogorov-Smirnov goodness-of-fit tests to determine the most appropriate distribution to use; learn to determine the confidence limits on the reliability for the exponential, normal, lognormal, Weibull, and binomial cases; determine the operating characteristic curves of components and products; plan, conduct, and analyze the results of sudden death, suspended-items, percent survival, success run, C-rank, and nonparametric tests; and plan, conduct and analyze the results of sequential, Bayesian, and accelerated tests.

Contact: Mr. Stod Cordelyou, Assistant Director, Continuing Engineering Education Program, The

George Washington University, Washington, D.C. 20052 - (202) 676-6106, (800) 424-9773, Telex: 64374 (International).

COMPUTATIONAL WORKSHOP IN LINEAR AND NONLINEAR STRUCTURAL AND SOLID MECHANICS

Dates: July 27-31, 1981
Place: Schenectady, New York
Objective: For those interested in applications to current technological problems such as earthquake analysis, pipe whip dynamics and fluid-solid interaction, as well as other areas. The following will be covered: structural dynamics techniques for both linear and nonlinear many-degree-of-freedom systems; incremental loading into the plastic range and finite element methods in fracture mechanics; random vibration methods; response spectrum methods for many-degree-of-freedom systems. A nonlinear dynamics computer program as well as eigenvalue and sinusoidal analysis programs will be available for workshop use. Relative merits of ANSYS, SAP, ADINA, etc., programs will be discussed. Computer graphics for input generation and output presentation will be available.

Contact: Union College, Graduate Studies and Continuing Education, Wells House - 1 Union Ave., Schenectady, New York 12308 - (518) 370-6288.

COMPUTER WORKSHOP IN FINITE ELEMENT METHODS OF ANALYSIS FOR STRESS AND OTHER FIELD PROBLEMS

Dates: July 27-31, 1981
Place: Schenectady, New York
Objective: For those interested in applications to current technological problems such as thermal and stress analysis of nuclear vessel nozzle, 3D pipe intersection, turbine blade application, water mass of nuclear fuel channels, as well as other areas. The following will be covered: finite element techniques for 2D and 3D structural analysis and dynamics; both 2D and 3D programs, including listings; generalization of finite element methods to heat transfer and fluid flow with programs in each discipline; incremental loading into the plastic range and finite element methods in fracture mechanics; relative merits of ANSYS, SAP, ADINA, etc., programs. Computer graphics for input generation and output presentation will be available.

Contact: Union College, Graduate Studies and Continuing Education, Wells House - 1 Union Ave., Schenectady, New York 12308 - (518) 370-6288.

AUGUST

MACHINERY DATA ACQUISITION

Dates: August 3-7, 1981
September 28 - October 2, 1981
December 7-11, 1981
Place: Carson City, Nevada
Objective: This seminar is designed for people whose function is to acquire machinery data for dynamic analysis, using specialized instrumentation, and/or that person responsible for interpreting and analyzing the data for the purpose of corrective action on machines. Topics include measurement and analysis parameters, basic instrumentation review, data collection and reduction techniques, fundamental rotor behavior, explanation and symptoms of common machinery malfunctions, including demonstrations and case histories. The week also includes a lab workshop day with hands-on operation of the instrumentation and demonstration units by the participants.

Contact: Kathy Fredekind, Bently-Nevada Corporation, P.O. Box 157, Minden, Nevada 89423 - (702) 782-3611, Ext. 224.

RELIABILITY AND LIFE TESTING

Dates: August 10-14, 1981
Place: Los Angeles, California
Objective: To cover the following subjects: Methodologies to improve the reliability of components, equipment and systems; follow their reliability growth; identify the distributions of their times-to-failure; determine their mean life, their reliability, and their failure rate, with their confidence limits at specified confidence levels; various new small-sample-size, short-duration reliability and life tests; non-parametric reliability and life tests; sequential tests for the exponential and binomial cases; tests of comparison for the exponential, Weibull and binomial cases; accelerated life testing; Bayesian life and reliability testing; identification of the appropriate times-to-failure distributions to use and the applica-

tion of goodness-of-fit tests to distributions fitted to data; probability plotting techniques to find the parameters of the appropriate distributions to use.

Contact: Mr. Robert Rector, Assistant Director - Short Courses, UCLA, 6266 Boelter Hall, Los Angeles, CA 90024 - (213) 825-3496/1295/3344.

FOUNDATIONS OF ENGINEERING ACOUSTICS

Dates: August 10-21, 1981
Place: Cambridge, Massachusetts
Objective: This summer program is a specially developed course of study which is based on two regular MIT subjects (one graduate level and one undergraduate level) on vibration and sound in the Mechanical Engineering Department. The program emphasizes those parts of acoustics - the vibration of resonators, properties of waves in structures and air - the generation of sound and its propagation that are important in a variety of fields of application. The mathematical procedures that have been found useful in developing the desired equations and their solutions, and the processing of data are also studied. These include complex notation, fourier analysis, separation of variables, the use of special functions, and spectral and correlation analysis.

Contact: Director of Summer Session, Room E19-356, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139.

PYROTECHNICS AND EXPLOSIVES

Dates: August 17-21, 1981
Place: Philadelphia, Pennsylvania
Objective: The seminar combines the highlights of Pyrotechnics and Solid State Chemistry, given the last twelve summers, and Explosives and Explosive Devices that made its successful appearance ten years ago. Similar to previous courses, the seminar will be practical so as to serve those working in the field. Presentation of the theory is restricted to that necessary for an understanding of basic principles and successful application to the field. Coverage emphasizes recent effort, student problems, new techniques, and applications.

Contact: Mr. E.E. Hannum, Registrar, The Franklin Research Center, Philadelphia, Pennsylvania 19103 - (215) 448-1236/1395.

VIBRATION AND SHOCK SURVIVABILITY, TESTING, MEASUREMENT, ANALYSIS, AND CALIBRATION

Dates: August 24-28, 1981
Place: Santa Barbara, California
Dates: October 5-9, 1981
Place: Bournemouth, England
Objective: Topics to be covered are resonance and fragility phenomena, and environmental vibration and shock measurement and analysis; also vibration and shock environmental testing to prove survivability. This course will concentrate upon equipments and techniques, rather than upon mathematics and theory.

Contact: Wayne Tustin, 22 East Los Olivos St., Santa Barbara, CA 93105 - (815) 682-7171.

MECHANICAL ENGINEERING

Dates: August 31 - September 4, 1981
Place: Carson City, Nevada
Objective: This course is designed for the mechanical or maintenance engineer who has responsibility for the proper operation and analysis of rotating machinery. Working knowledge of transducers, data acquisition instrumentation and fundamental rotor behavior is a prerequisite. The course includes: a guest speaker in the field of machinery malfunctions; descriptions and demonstrations of machinery malfunctions; discussions of the classification, identification, and correction of various machine malfunctions; a one day rotor dynamics lab with individual instruction and operation of demonstration units; and emphasis on the practical solution of machinery problems rather than rotor dynamic theory.

Contact: Kathy Fredekind, Bently-Nevada Corporation, P.O. Box 157, Minden, Nevada 89423 - (702) 782-3611, Ext. 224.

SEPTEMBER

10TH ADVANCED NOISE AND VIBRATION COURSE

Dates: September 14-18, 1981
Place: Southampton, England
Objective: The course is aimed at researchers and development engineers in industry and research establishments, and people in other spheres who are

associated with noise and vibration problems. The course, which is designed to refresh and cover the latest theories and techniques, initially deals with fundamentals and common ground and then offers a choice of specialist topics. The course comprises over thirty lectures, including the basic subjects of acoustics, random processes, vibration theory, subjective response and aerodynamic noise, which form the central core of the course. In addition, several specialist applied topics are offered, including aircraft noise, road traffic noise, industrial machinery noise, diesel engine noise, process plant noise and environmental noise and planning.

Contact: Mrs. O.G. Hyde, ISVR Conference Secretary, The University, Southampton S09 5NH, England - (0703) 559122 X 2310/752, Telex 47661.

BASIC INSTRUMENTATION SEMINAR

Dates: September 15-17, 1981
Place: New Orleans, Louisiana
Dates: October 20-22, 1981
Place: Houston, Texas
Dates: October 27-29, 1981
Place: Pittsburgh, Pennsylvania
Objective: This course is designed for maintenance technicians, instrument engineers, and operations personnel - those individuals responsible for installation and proper operation of continuous monitoring systems. An in-depth examination of probe installation techniques and monitoring systems including types, functions, and calibration procedures is provided. Also presented is an overview of some of the instrumentation used to acquire data for vibration analysis, including oscilloscopes, cameras, and specialized filter instruments.

Contact: Kathy Fredekind, Bently-Nevada Corporation, P.O. Box 157, Minden, Nevada 89423 - (702) 782-3611, Ext. 224.

OCTOBER

UNDERWATER ACOUSTICS

Dates: October 5-9, 1981
Place: University Park, Pennsylvania
Objective: This course is designed to introduce the basic principles and concepts of underwater acoustics to those new to the field as well as to serve as a refresher for those who need to become acquainted with recent advances. Topics presented include underwater sound propagation, sonar concepts, ambient noise and reverberation considerations, transducer technology, nonlinear acoustics and parametric arrays, target physics, and radiated and self noise due to turbulent flows and cavitation.

Contact: Alan D. Stuart, Course Chairman, The Applied Research Laboratory, The Pennsylvania State University, P.O. Box 30, State College, PA 16801 - (814) 865-1397.

DESIGN OF FIXED OFFSHORE PLATFORMS

Dates: October 5-16, 1981
April 5-16, 1982
Place: Austin, Texas
Objective: This course is dedicated to the professional development of those engineers, scientists, and technologists who are and will be designing fixed offshore platforms to function in the ocean environment from the present into the twenty-first century. The overall objective is to provide participants with an understanding of the design and construction of fixed platforms, specifically the theory and processes of such design and the use of current, applicable engineering methods.

Contact: Continuing Engineering Studies, College of Engineering, Ernest Cockrell Hall 2.102, The University of Texas at Austin, Austin, Texas 78712 - (512) 471-3506.

VIBRATION CONTROL

Dates: October 12-16, 1981
Place: University Park, Pennsylvania
Objective: The seminar emphasizes principles, general approaches and new developments, with the aim of providing participants with efficient tools for dealing with their own practical vibration problems.

Contact: Debra A. Noyes, 410 Keller Conference Center, University Park, Pennsylvania 16802 - (814) 865-8820, TWX No: 510-670-3532.

NEWS BRIEFS: news on current and Future Shock and Vibration activities and events

TURBOMACHINERY SYMPOSIUM
Houston, Texas
December 1-3, 1981

The Tenth Turbomachinery Symposium, to be held at the Shamrock Hilton Hotel, Houston, Texas on December 1, 2, and 3, 1981 is sponsored by the Turbomachinery Laboratories at Texas A&M University.

The object of the Symposium is to provide interested persons with the opportunity to learn the applications and principles of various types of turbomachinery, to enable them to keep abreast of the latest developments in this field, and to provide a forum wherein those who attend can exchange ideas. In this exchange of information, users, manufacturers, basic design engineers, and technicians will get together and discuss problem areas. They will also attend lectures, panel sessions, and tutoriums that will inform them of the latest developments in the area of turbomachines and related equipment. A product show, which is also part of the activities, attracted 92 exhibitors last year. The past exhibits have ranged from large turbomachinery parts to various types of monitoring and maintenance devices.

For further information, contact: Peter E. Jenkins, Ph.D., P.E., Director, Turbomachinery Laboratories, Dept. of Mechanical Engineering, Texas A&M University, College Station, TX 77843 - (713) 845-7417.

REVIEWS OF MEETINGS

SPRING CONFERENCE OF INSTITUTE OF ACOUSTICS, UK
Newcastle-upon-Tyne, England
April 21-24, 1981

This annual meeting of the I.O.A. was of special interest to those interested in shock and vibration. In addition to some 42 papers on Structural Dynamics, there were sessions on Industrial Noise, Speech and Hearing, Musical Acoustics, and the following special general papers:

1981 Rayleigh Medal Lecture
"Acoustics in Physics and Engineering"
Professor K. Uno Ingard, MIT

1980 Tyndall Medal Lecture
"Sound Insulation in Buildings -- A Review"
Dr. R.K. McKenzie, Heriot Watt University

Specialist Lecture I
"Acoustics and the Performance of Music"
Dr. Ing. Jurgen Meyer, PTB Braunschweig, W. Germany

Specialist Lecture II
"Vibration and Noise Relationships: Some Simple Rules for the Machinery Engineer"
Professor E.J. Richards, ISVR, University of Southampton

Presidential Address
"A Structural Dynamicist Looks at Statistical Energy Analysis"
Professor B.L. Clarkson, ISVR, University of Southampton

Biennially the I.O.A. offers a continuous program of papers on Structural Dynamics at its Spring Conference and there were sufficient papers this year to make these up into two parallel sessions.

The applications concerned in these papers covered ships, off-shore structures, road vehicles, railway vehicles, spacecraft, buildings, wind turbines, and fans and brought together a large number of specialist engineers from these various fields.

Bound copies of extended summaries of all the papers are available from the Secretary, Instititue of Acoustics, 25 Chambers Street, Edinburgh, EH1 1HU, UK.

D.J. Johns

INFORMATION RESOURCES

NONDESTRUCTIVE TESTING INFORMATION ANALYSIS CENTER

The Nondestructive Testing Information Analysis Center (NTIAC) is operated by Southwest Research Institute in San Antonio, Texas. It was established in 1974 under contract to the Defense Supply Agency to support the Department of Defense in its mission to provide a source of information, analysis and service in NDT. Its objective is to assist on a partially self supporting basis the nation's scientists and engineers to become more productive. In recognition of this special mission the Department of Defense personnel technical monitorship of NTIAC is provided by the Army Materials and Mechanics Research Center in Watertown, Massachusetts. NTIAC has attained full service capability as an information analysis center in nondestructive testing, meaning that it can act on all nondestructive testing problems in any degree required, extending from the assistance in finding available information to the full scale technical analysis and evaluation of the problem. To do so NTIAC makes use of the staff experts at Southwest Research Institute, comprising in excess of 400 scientists and engineers representing nearly every discipline in the physical and engineering sciences. However, the NTIAC primary base for technical assistance is within the body of scientific and engineering information, which is growing exponentially as man extends his technological horizon. NDT information is imbedded in this plethora of literature and it is NTIAC's function to fin, collect, evaluate, store and disseminate this body of NDT information. Based upon it, NTIAC produces bibliographies, handbooks, technical works, and current awareness periodicals. Most important, it is able to render technical assistance as required. In furnishing its products and services, NTIAC utilizes the sources of special information analysis support services of the Defense Technical Information Center (DTIC). These services consist of a stored dedicated reference bibliographic data file on NDT information and retrieval, by computer search in the file, of appropriate references to satisfy customers needs. A Department of Defense Research and Development Test and Equipment (RDT&E) remote terminal at NTIAC places it in contact with resources of DTIC.

NTIAC primarily supports DoD components, contractors, and grantees, other U.S. Government agencies and their contractors and the private sector as well. The scope of this support is indicated by its document base which is now over 20,000 items and growing at a rate of about 200 documents per month. In view of the present world situation relative to materials and energy insufficiencies the significance of the subject matter covered in the major categories, methodology, testability data, quality, and reliability data, and NDT engineering cannot help but increase, and the potential applications of NTIAC's products and services will increase concurrently. It is important that the NDT community is kept aware of NDT technical information, have problem solving assistance available, know the state-of-the-art, have standards, be able to incorporate NDT at the design stage, make cost effectiveness studies, prepare and respond to the needs of the general society and train its personnel. NTIAC is committed to meeting effectively requirements for information analysis services in these vital areas.

NTIAC publishes the NTIAC monthly Newsletter, available without charge to qualified subscribers. Also available is a NTIAC User's Guide describing the services available from NTIAC and how to obtain them. Both publications mentioned above, as well as other information, may be obtained by writing or calling NTIAC, P.O. Box 28510, San Antonio, Texas 78284, telephone 512-684-5111, ext. 2362.

ABSTRACTS FROM THE CURRENT LITERATURE

Copies of articles abstracted in the DIGEST are not available from the SVIC or the Vibration Institute (except those generated by either organization). Inquiries should be directed to library resources. Government reports can be obtained from the National Technical Information Service, Springfield, VA 22151, by citing the AD-, PB-, or N- number. Doctoral dissertations are available from University Microfilms (UM), 313 N. Fir St., Ann Arbor, MI; U.S. Patents from the Commissioner of Patents, Washington, D.C. 20231. Addresses following the authors' names in the citation refer only to the first author. The list of periodicals scanned by this journal is printed in issues 1, 6, and 12.

ABSTRACT CONTENTS

MECHANICAL SYSTEMS

ROTATING MACHINES

(Also see Nos. 1427, 1533, 1538, 1540, 1543, 1564, 1565)

81-1403

Summed-and-Differential Harmonic Oscillations of an Unsymmetrical Shaft

T. Yamamoto, Y. Ishida, and T. Ikeda
Nagoya Univ., Chikusa-ku, Nagoya, Japan, Bull. JSME, 24 (187), pp 183-191 (Jan 1981) 14 figs, 10 refs

Key Words: Shafts, Harmonic response

In this report it is shown that the following types of resonance curves are obtained depending on the degrees of nonlinearity and unbalance. They are a stable resonance curve of hard spring type, a stable resonance curve of soft spring type, an unstable region where unstable vibration appears, and the case where no summed-and-differential harmonic oscillation occurs. Experiments were made with an unsymmetrical shaft supported by single-row deep groove ball bearings. The above-mentioned resonance curves were obtained in experiments.

81-1404

Internal Damping and Stability of Rotor-shaft Systems

K. Nonami and M. Miyashita
Tokyo Metropolitan Univ., Setagaya-ku, Tokyo, Japan, Bull. JSME, 24 (187), pp 200-207 (Jan 1981) 14 figs, 11 refs

Key Words: Rotors, Shafts, Internal damping, Experimental test data

Observing a structural damping caused by the method of fitting the rotor into the rotating shaft, this paper reports on experimental studies of the structural damping, the estimated values of the internal damping and stabilities of many rotors. From these experimental results, it has been found that the fitting methods bear relations to the stabilities and one view has been obtained. This paper shows theoretically and experimentally that the self-excited vibration of this kind can be prevented by supporting the rotating shaft flexibly.

81-1405

Flexibility and Strength of Flexible Shaft (1st Report, Case of Bending)

K. Mizoguchi, K. Shirakawa, and H. Fujiwara
The Faculty of Science and Tech., Kinki Univ., Kowakae, Higashi-Osaka, Bull. JSME, 24 (187), pp 1-8 (Jan 1981) 10 figs, 5 refs

Key Words: Shafts (machine elements), Flexible rotors, Rotors, Cylindrical shells, Flexural stiffness

This paper is concerned with the analytical and experimental studies of a cylindrical shell cut by a spiral groove, the so-called flexible shaft. The analysis of the flexible shaft under a uniform bending is carried out by using the theory of a cylindrical shell. The relations between the angle of the spiral groove, thickness of shell, radius of cylinder and width of band element, and the flexibility, displacement and stresses of the flexible shaft are shown. The discussion on the flexibility of the shaft with or without groove suggests how the groove affects the flexibility of the shaft. Some experimental data are presented for the displacmeent and strain, and the comparison between them assures the validity of theoretical analysis.

81-1406

An Experimental Investigation on the Response of a Flexible Rotor Mounted in Pressure Dam Bearings

R.D. Flack, M.E. Leader, and E.J. Gunter
Dept. of Mech. and Aerospace Engrg., School of Engrg. and Appl. Science, Univ. of Virginia, Charlottesville, VA 22901, J. Mech. Des., Trans. ASME, 102 (4), pp 842-849 (Oct 1980) 19 figs, 4 tables, 4 refs

Key Words: Rotors, Flexible rotors, Fluid-film bearings, Pressure dam bearings, Experimental test data

The response of a flexible rotor mounted in six bearing sets has been experimentally determined. One set of axial groove bearings and five sets of pressure dam bearings were tested. Conventional synchronous tracking was used in the analysis and other techniques utilizing an FFT analyzer were developed. The stability of the system was seen to strongly depend on the design of the step bearings. The dam bearings were also noted to lock into subsynchronous whip during deceleration after the system went unstable. The response of the system with varying degrees of unbalance is also analyzed and several structural resonances of the rotor system are discussed.

81-1407

Subharmonic and Summed-and-Differential Harmonic Oscillations of an Unsymmetrical Rotor

T. Yamamoto, Y. Ishida, T. Ikeda, and M. Yamada
Nagoya Univ., Chikusa-ku, Nagoya, Japan, Bull. JSME, 24 (187), pp 192-199 (Jan 1981) 16 figs, 4 refs

Key Words: Rotors, Asymmetry, Subharmonic oscillations, Harmonic response

Subharmonic and summed-and-differential harmonic oscillations of a nonlinear rotating shaft system where an unsymmetrical rotor is mounted on a shaft with circular cross section are treated. It becomes clear theoretically that the resonance curves of subharmonic oscillations of order ½ and summed-and-differential harmonic oscillations are classified into four types. Therefore, similarly to those of an unsymmetrical shaft system reported previously, stable oscillation, unstable oscillation, or no oscillation appears. In an experimental apparatus in which single-row deep groove ball bearings were used, the same types of the resonance curves as the theoretical results were observed by changing the assembly of the apparatus and the size and location of the existing unbalance.

81-1408

Influence of Errors on the Vibration of Rotor/Bearing System

T. Iwatsubo
The Faculty of Engrg., Kobe Univ., Rokko, Nada, Kobe, Japan, Bull. JSME, 24 (187), pp 208-214 (Jan 1981) 8 figs, 2 tables, 3 refs

Key Words: Rotors, Error analysis, Statistical analysis, Unbalanced mass response, Critical speeds

This paper deals with the error analysis of the vibration of rotor/bearing systems. If the statistical properties of errors (i.e., mean values and standard deviations) are known, the mean value and standard deviation of unbalance response and critical speed may be obtained and the probability of instability may be calculated. It is concluded that the critical speed is not greatly affected by the errors, but the real part of the eigenvalue which is very important for instability is sensitively affected. The amplitude of the vibration for mass and stiffness errors varies with high sensitivity near the critical speed.

81-1409

Synchronous Unbalance Response of an Overhung Rotor with Disk Skew

D.J. Salamone and E.J. Gunter
Allis-Chalmers Corp., Milwaukee, WI, J. Engrg. Power, Trans. ASME, 102 (4), pp 749-755 (Oct 1980) 10 figs, 1 table, 15 refs

Key Words: Rotors, Flexible rotors, Synchronous vibration, Unbalanced mass response, Geometric imperfection effects

This paper deals with the influence of disk skew on the synchronous unbalance response of flexible rotors in damped bearings. A simple overhung rotor is treated to illustrate the effects of various combinations of unbalance and disk skew on the amplitude and phase angle response at the disk and bearings. The paper shows that it is impossible to balance the rotor at all speeds by single plane balancing even if three correction planes are employed. The presence of disk skew may be best detected by monitoring the far bearing for a rapid phase angle decrease after passing through the first critical speed.

81-1410

A Finite Rotating Shaft Element Using Timoshenko Beam Theory

H.D. Nelson
Arizona State Univ., Tempe, AZ, J. Mech. Des., Trans. ASME, 102 (4), pp 793-803 (Oct 1980) 6 figs, 2 tables, 13 refs

Key Words: Shafts, Rotors, Timoshenko theory, Finite element technique

The use of finite elements for simulation of rotor systems has received considerable attention within the last few years. The published works have included the study of the effects of rotatory inertia, gyroscopic moments, axial load, and internal damping; but have not included shear deformation or axial torque effects. This paper generalizes the previous works by utilizing Timoshenko beam theory for establishing the shape functions and, thereby including transverse shear effects. Internal damping is not included but the extension is straight forward. Comparison is made of the finite element analysis with classical closed form Timoshenko beam theory analysis for nonrotating and rotating shafts.

81-1411

Application of Numerical Optimization to Drive Shaft Design

V.S. Merced
Naval Postgraduate School, Monterey, CA, Master's Thesis, 85 pp (June 1980)
AD-A092 400/1

Key Words: Shafts (machine elements), Unbalanced mass response, Whirling, Optimization, Design techniques

The application of numerical optimization techniques to the design of drive shafts is demonstrated. The analysis investigated the effects of a small mass imbalance in conjunction with the rotation of a shaft with synchronous whirl.

81-1412

Stability of Large Horizontal-Axis Axisymmetric Wind Turbines

M.S. Hirschbein and M.I. Young

NASA Lewis Res. Ctr., Cleveland, OH, Presented at 3rd Miami Conf. on Alternative Energy Sources, Miami, 15-17 Dec 1980, Rept. No. NASA-TM-81623; E-633, 37 pp (1980)

N81-12446

Key Words: Wind turbines, Dynamic stability

The stability of large horizontal axis, axi-symmetric, power producing wind turbines was examined. The analytical model used included the dynamic coupling of the rotor, tower and power generating system. The aerodynamic loading was derived from blade element theory. Each rotor blade was permitted two principal elastic bending degrees of freedom, one degree of freedom in torsion and controlled pitch as a rigid body. The rotor hub was mounted in a rigid nacelle which may yaw freely or in a controlled manner. The tower can bend in two principal directions and may twist. Also, the rotor speed can vary and may induce perturbation reactions within the power generating equipment. Stability was determined by the eigenvalues of a set of linearized constant coefficient differential equations. Some of the parameters varied were: wind speed, rotor speed structural stiffness and damping, the effective stiffness and damping of the power generating system and the principal bending directions of the rotor blades. Unstable or weakly stable behavior can be caused by aerodynamic forces due to motion of the rotor blades and tower in the plane of rotation or by mechanical coupling between the rotor system and the tower.

81-1413

Effect of Inflow Control on Inlet Noise of a Cut-on Fan

R.P. Woodward and F.W. Glaser

NASA Lewis Res. Ctr., Cleveland, OH, AIAA J., 19 (3), pp 387-392 (Mar 1981) 15 figs, 12 refs

Key Words: Jet engines, Turbofans, Fans, Noise generation, Noise measurement, Measurement techniques

A cut-on, high-tip speed fan stage was acoustically tested with three configurations of an inflow control device in the NASA Lewis anechoic chamber. Although this was a cut-on design, rotor-inflow interaction appeared to be a much stronger source of blade passing tone radiated from the inlet than rotor-stator interaction for the 1.6 mean rotor chord separation. Aft external suction applied to the area where the inflow control device joined the inlet produced a further reduction in blade passing tone suggesting that disturbances in the forward flow on the outside of the inlet were superimposed on the inlet boundary layer and were a significant source of tone noise.

81-1414

Flight Noise Simulation in an Anechoic Chamber

R.A. Kantola and R.E. Warren

General Electric Corporate Res. and Dev., Schenectady, NY, AIAA J., 19 (3), pp 350-357 (Mar 1981) 12 figs, 22 refs

Key Words: Jet engines, Fans, Noise measurement, Measurement techniques

A widely recognized problem in the jet engine industry is the discrepancy between inflight measurements of fan noise as compared to static tests. This discrepancy consists of blade passing frequency tones, caused by ingested turbulence and flow distortions that appear in the static tests but do not appear in flight. An intensive effort has been carried out to devise means by which an anechoic chamber could be employed to yield fan noise data of the type that one obtains in flight. This effort has succeeded in reducing the ingested turbulence, to the point where reductions in the acoustic power at blade passing frequency are as high as 18 dB for subsonic tip speeds. Turbulence mapping of the inlet has confirmed that the tone reductions are due to a reduction in turbulence, as the low frequency (large scale) streamwise and transverse turbulent velocities have been reduced by up to four times and ten times, respectively.

81-1415

Dynamics of Power Plant Fan-Foundation Systems. Final Report

K. Medearis

Medearis and Associates, Fort Collins, CO, 102 pp (July 1980)

EPRI-CS-1440

Key Words: Electric power plants, Fans, Vibration analysis

The vibratory responses of large fan systems continues to be a problem at numerous power plants. This research study has provided further insight concerning methods of analyzing and predicting such responses. Refinement and verification of the total system dynamic analysis procedures was accomplished in the investigation. The equivalencing of experimental measurements taken on existing fan systems with theoretical response results provided one of the bases for this effort. Five large, induced-draft fans and two smaller, primary air fans were utilized for the comparisons, good agreement being obtained in all cases.

81-1416
Hydraulic and Dynamic Instabilities in Feed Pumps in Large Fossil and Nuclear Applications in the U.S.A.
E. Makay and I.A. Diaz-Tous
Energy Res. & Consultant Corp., Morrisville, PA, ASME Paper No. 80-JPGC/Pwr-21

Key Words: Pumps, Electric power plants, Fossil power plants, Nuclear power plants

A comprehensive industry-wide survey was made, which provided ample data to identify the most important causes of availability loss resulting from failures or malfunctioning of boiler feed, nuclear feed, and feed water booster pumps. The specific design, technology, operation and maintenance deficiencies and system related problems responsible for most outages involving pump failures are summarized.

POWER TRANSMISSION SYSTEMS

81-1417
Role of Induction Driving Motor in Transmission Dynamics
E.I. Rivin
Ford Motor Co., Dearborn, MI, ASME Paper No. 80-DET-96

Key Words: Power transmission systems, Torsional vibration

Torsional vibrations and peak dynamic overloads can be very important considerations in a transmission design. The role of the driving induction motor as an origin of peak overloads is shown and techniques for calculating the overloads are derived and experimentally verified.

METAL WORKING AND FORMING

81-1418
Sources of Noise Produced During Pneumatic Chipping Hammer Operation
H.A. Scarton, W.C. Kennedy, and J.A. Lacey
Rensselaer Polytechnic Inst., Troy, NY, ASME Paper No. 80-WA/NC-11

Key Words: Machine tools, Noise generation

The results of noise tests performed on a pneumatic metal chipping hammer are presented. Detailed mechanical signature analysis of the chipping hammer signal is presented.

81-1419
Transfer Matrix Analysis of an Electrohydraulically Driven Rotary-Vibratory Drilling System
D.C. Ohanehi
Ph.D. Thesis, Virginia Polytechnic Inst. and State Univ., 269 pp (1980)
UM 8101895

Key Words: Drills, Vibratory tools, Transfer matrix method

This thesis reports on a transfer matrix model for the longitudinal vibratory component of a rotary-vibratory drilling (RVD) system driven with an electrohydraulic inertial mass exciter. The RVD system is a hybrid drilling system consisting of a conventional rotary drilling system assisted by forced harmonic vibrations. The model includes a drill string with continuously distributed inertia, stiffness, internal material, and external fluid damping. These properties were introduced through a new continuum transfer matrix for a damped pipe element. The model allows for the inclusion of realistic geometrical representations for the drill string, and the inclusion of masses, springs, dashpots, and other axial structural elements.

STRUCTURAL SYSTEMS

BRIDGES
(See No. 1570)

BUILDINGS

81-1420
Airborne Isolation Measurements by Impulse Technique
J. Roland
Centre Scientifique et Technique du Batiment, 24 rue Joseph Fourier, 38400 St. Martin d'Heres, France, Noise Control Engrg., 16 (1), pp 6, 7-14 (Jan/Feb 1981) 10 figs, 3 tables, 9 refs

Key Words: Buildings, Noise reduction, Measurement techniques, Time domain method, Real time spectrum analyzers

The measurement of airborne isolation in building constructions is possible in the time domain by using noises of short duration and a real time analyzer to process data. By using an impulsive noise it is possible to considerably lighten the measuring equipment, to make the measurement in the presence of an important background noise and to reduce the measurement and analysis time while maintaining precision. A detailed study of the parameters affecting the precision of the results is presented. The comparison between the results obtained using a continuous noise method and the reported method shows a difference of less than 2 dB(A).

UNDERGROUND STRUCTURES

81-1421
Laboratory Study of Deep-Based Structures in Support of DIABLO HAWK
P.E. Seneny and H.E. Lindberg
SRI International, Menlo Park, CA, Rept. No. DNA-4380F, 135 pp (Feb 1, 1978)
AD-A091 370/7

Key Words: Underground structures, Hardened installations, Cable stiffened structures

Laboratory studies were performed in support of DIABLO HAWK structures and cable-hardening experiments to investigate: the influence of loading rate on tunnel closure in both water-saturated and dry specimens of SRI RMG 2C2, a tuff simulant; borehole collapse mechanisms and borehole/cable interaction; and the influence of joints and joint orientation on the closure of circular tunnels in specimens of jointed 16A rock simulant.

HARBORS AND DAMS

81-1422
Effect of Stratification on Hydrodynamic Pressures on Dams
A.T. Chwang
Inst. of Hydraulic Res., The Univ. of Iowa, Iowa City, IA 52242, J. Engrg. Math., 15 (1), pp 49-63 (Jan 1981) 6 figs, 13 refs

Key Words: Dams, Seismic design

The effect of stratification of the fluid in the reservoir on hydrodynamic pressures on dams due to horizontal, harmonic ground accelerations has been analyzed. It has been found that both the zeroth-order solution, which corresponds to the constant-density solution, and the first-order solution have two components in the hydrodynamic pressure distribution, an in-phase component and an out-of-phase component which is 90° lagging. The out-of-phase components vanish in the absence of surface waves, and they become dominant when the wave-effect parameter becomes large.

81-1423
Random Hydrodynamic Force on Dams from Earthquakes
C.Y. Yang and V. Chiarito
Dept. of Civil Engrg., Delaware Univ., Newark, DE, Rept. No. W81-00378, OWRT-A-047-DEL(2), 25 pp (1980)
PB81-124166

Key Words: Dams, Earthquake damage, Seismic response

A new solution for the hydrodynamic force on gravity dams during earthquakes has been obtained. The horizontal acceleration of earthquakes is modeled by a time-dependent random process and the force response solution is given in terms of non-stationary power spectral density and the mean-square function.

81-1424
Seismic Risk Analysis of Wilmington, Delaware
C.Y. Yang and P. Dressel
Dept. of Civil Engrg., Delaware Univ., Newark, DE, Rept. No. W81-00379, OWRT-A-047-DEL(1), 37 pp (1980)
PB81-124174

Key Words: Dams, Concretes, Seismic response, Earthquake damage

A seismic risk analysis is carried out for Wilmington, Delaware where an old and deteriorating concrete dam is located. The result confirms the prediction by the U.S. Geological Survey showing a risk of about 10% in 50 years for the occurrence of an earthquake ground acceleration of 0.04g. Extensions of predictions provide information for safety planning and strengthening of this dam.

POWER PLANTS

(Also see Nos. 1415, 1416, 1488, 1539, 1544, 1545)

81-1425

Structural Uncertainty in Seismic Risk Analysis; Seismic Safety Margins Research Program

T.K. Hasselman and S.S. Simonian

Lawrence Livermore National Lab., CA, Rept. No. UCRL-15218, 146 pp (Oct 1980)
NUREG/CR-1560

Key Words: Nuclear power plants, Modal analysis

This report documents the formulation of a methodology for modeling and evaluating the effects of structural uncertainty on predicted modal characteristics of the major structures and substructures of commercial nuclear power plants. The uncertainties are case in the form of normalized random variables which represent the demonstrated ability to predict modal frequencies, damping and modal response amplitudes for broad generic types of structures (steel frame, reinforced concrete and prestressed concrete). Data based on observed differences between predicted and measured structural performance at the member, substructure, and/or major structural system levels are used to quantify uncertainties and thus form the data base for statistical analysis. The report also documents the results of a data survey to identify, classify and evaluate available data for the required data base. A bibliography of 95 references is included. Deficiencies in the currently identified data base are exposed, and remedial measures suggested. Recommendations are made for implementation of the methodology.

81-1426

Design of Steel Energy Absorbing Restrainers and Their Incorporation into Nuclear Power Plants for Enhanced Safety. Volume 1C: Numerical Method for Dynamic Substructure Analysis

J.M. Dickens and E.L. Wilson

Earthquake Engineering Research Inst., Berkeley, CA, UCB/EERC-80/20-1C, 208 pp (June 1980)
N80-15160

Key Words: Nuclear power plants, Energy absorption, Substructuring methods

Several numerical methods for the dynamic response analysis of large complex structural systems are presented. The methods presented are primarily concerned with linear dynamic analysis. However, one of the significant results of the research is the development of efficient numerical methods for large systems with a small number of nonlinear members. The technique of dynamic substructure analysis is used to accurately model the behavior of the linear part of the system.

81-1427

Air/Gas System Dynamics of Fossil Fuel Power Plants. Volume 3. Experimental Pressure Test Data of a 500-MW Unit and of a 125-MW Unit

F.R. Goldschmied, D.N. Wormley, D. Rowell, and J.E. Brown, Jr.

Westinghouse Res. Labs., Pittsburgh, PA, 92 pp (Sept 1980)
EPRI-CS-1444 (V.3)

Key Words: Electric power plants, Fossil power plants, Fans, Fluid-induced excitation

This study addresses combustion air/flue gas system dynamic problems in fossil fuel power plants. These problems are characterized in terms of significant pressure and flow dynamic variations. These dynamic pressure variations have led to equipment and ductwork vibrations in a number of plants which have eventually resulted in ductwork and/or equipment failure. Methods have been developed for instrumenting plants and analyzing data to identify sources of air/gas system dynamic problems. These techniques were applied to two oil-fired, balanced-draft plants to obtain data for cold and hot operation.

OFF-SHORE STRUCTURES

81-1428

The Determination of Modal Damping Ratios from Maximum Entropy Spectral Estimates

J.K. Vandiver and R.B. Campbell

Massachusetts Inst. of Tech., Cambridge, MA, ASME Paper No. 80-WA/DSC-29

Key Words: Offshore structures, Modal damping, Natural frequencies, Mode shapes

Substantial effort has been expended in attempts to estimate dynamic response parameters of offshore structures. Natural frequencies, mode shapes and damping ratios have been estimated with varying degrees of success. A portion of the effort has been motivated by active research and development of structural integrity monitoring systems.

VEHICLE SYSTEMS

GROUND VEHICLES

(Also see No. 1541)

81-1429

Modeling and Dynamic Response of Maglev Vehicles Subjected to Crosswind Gusts

D.P. Garg and T.M. Barrows
Duke Univ., Durham, NC, ASME Paper No. 80-WA/DSC-8

Key Words: Ground effect machines, Wind-induced excitation, Aerodynamic excitation

This paper presents a two-degree-of-freedom model for magnetically levitated finite-length vehicles incorporating sway and yaw dynamics. Aerodynamic lateral forces and yawing moments on the vehicle resulting from constant speed wind gusts were computed using analytical techniques. Computer simulations were run for three vehicle speeds and three apparent mass factors.

81-1430

Road Vehicle Train Response to Random Road Surface Undulations

M.M. Elmadany, M.A. Dokanish, and A.B. Allan
Wyle Lab., Colorado Springs, CO, ASME Paper No. 80-WA/DSC-1

Key Words: Ground vehicles, Surface roughness, Random excitation, Power spectra

This paper provides an approach for determining the random response of road vehicle train to the road surface undulations which are represented as stationary random excitations. The approach utilizes the power spectral density approach to solve the linear equations of motion.

81-1431

Nonstationary Response of Vehicles on Rough Ground -- A State Space Approach

J.K. Hammond and R.F. Harrison
Univ. of Southampton, UK, ASME Paper No. 80-WA/DSC-22

Key Words: Ground vehicles, Surface roughness

The motion of vehicles travelling over rough ground at variable speed is nonstationary. In this paper a method for the computation of response variance is presented which uses the concept of a "spatial" shaping filter to represent the uneven ground, leading to a state space form for the combination of vehicle and excitation. The formulation is for linear systems of arbitrary order and allows any deterministic velocity history to be accommodated easily.

81-1432

Mass-Production Solutions for Noise Reduction in a Door-to-Door Delivery Vehicle (In Serie realisierbare Losungen zur Gerauschminderung an einem Lastkraftwagen fur den Verteilerverkehr)

J. Fischer, P. Muhe, and G. Stangl
Tulpenweg 14, 7901 Bernstadt, Automobiltech. Z., 82 (12), pp 623-628 (Dec 1980) 11 figs
(In German)

Key Words: Ground vehicles, Noise reduction

Measures suitable for mass production and not requiring any changes on the basic vehicle concept were developed to reduce noise in a production truck equipped with an air-cooled, six-cylinder in-line Diesel engine. The noise reduction measures can be divided into three main stages for progressive application in the form of a modular system: engine-related measures, based on slight turbo-charging and reduced speed, engine partially boxed in by sound-absorbing panels in the car area, and engine/gearbox unit totally boxed in by sound-absorbing panels and structural parts lined with sound-absorbing material.

81-1433

Reduction of Cooling System Noise in Heavy-Duty Truck Design

K. Takeda

Isuzu Motors Ltd., Kawasaki-shi, Japan, Intl. J. Vehicle Des., 2 (1), pp 29-42 (Feb 1981) 19 figs, 1 table

Key Words: Trucks, Cooling systems, Noise reduction

Four major manufacturers of heavy vehicles jointly implemented a project: 'Development and Research of Low Noise Heavy Duty Trucks', under the guidance of M.I.T.I. Isuzu Motors Limited have conducted research into the reduction of noise in cooling systems. In heavy-duty vehicles, cooling fan noise is one of the biggest contributors to overall vehicle noise, second only to that of the engine itself. The experimental research described here, was carried out by classifying the subject into the following three areas: research concerning the specification and layout of cooling elements affecting noise characteristics and air inflow, research into the heat dissipation rate of radiators, and research into developing an optimum low-noise cooling system by coordinating the previous aspects.

81-1434

A Passenger Rail Truck Design Methodology

D. Horak and D.N. Wormley

Massachusetts Inst. of Tech., Cambridge, MA, Intl. J. Vehicle Des., 2 (1), pp 1-18 (Feb 1981) 11 figs, 3 tables, 12 refs

Key Words: Railroad cars, Suspension systems (vehicles), Interaction: rail-wheel

A design methodology is developed for passenger vehicle rail trucks in which primary and secondary suspension parameters and wheel/rail parameters are determined to meet a set of dynamic performance indices. The methodology partitions the design task into two basic tradeoff studies: a stability-curving tradeoff and a lateral ride quality-secondary stroke tradeoff. The design methodology is illustrated with both high-speed intercity and lower-speed urban rail truck designs.

81-1435

Stability and Curving Mechanics of Rail Vehicles

C.E. Bell, D. Horak, and J.K. Hedrick

Massachusetts Inst. of Tech., Cambridge, MA, ASME Paper No. 80-WA/DSC-15

Key Words: Railroad cars, Interaction: rail-wheel

This paper presents a unified treatment of stability and curving mechanics of steel wheel/steel rail vehicles utilizing low order, predominantly linear models. The analysis is applicable to both conventional and self-steering radial passenger trucks. A six-degree-of-freedom truck model is utilized to illustrate the various instability modes that can occur.

81-1436

Parametric Excitation of Rail Vehicle Wheelsets Due to Track Irregularity

T.D. Burton

Washington State Univ., Pullman, WA, ASME Paper No. 80-WA/DSC-20

Key Words: Railroad cars, Wheelsets, Track roughness, Parametric excitation

The effects of vertical and lateral track irregularity on the lateral stability of a simply restrained railway vehicle wheelset undergoing small amplitude motion are investigated. The influence of parametric excitation on the stability of wheelset motion and, in particular, on the lowering of the critical speed of secondary hunting, is examined analytically for the simple case of harmonic track irregularity. Depending on vehicle parameters and quality of track a substantial reduction in critical speed is possible.

81-1437

Evaluation of Time-Duration Dependent Wheel Load Criteria for Wheelclimb Derailment

L.M. Sweet and A. Karmel

Princeton Univ., Princeton, NJ, ASME Paper No. 80-WA/DSC-21

Key Words: Railroad cars, Interaction: rail-wheel

This paper shows that the JNR and other time-duration dependent criteria based on wheel load measurements alone are unsuccessful in predicting derailment safety. For wheelclimb processes involving negligible lateral velocities, the derailment limit can be estimated from quasisteady analysis of wheel/rail forces. The evaluation of criteria is based on experiments with a single wheelset and a nonlinear theory for dynamic wheelclimb.

81-1438

Fatigue Analysis of Railroad Freight Car Truck Bolster

D.B. Cooley and G.P. Shieh

Standard Car Truck Co., Chicago, IL, ASME Paper No. 80-WA/RT-6

Key Words: Railroad cars, Freight cars, Fatigue life, Finite element technique

Fatigue analysis of a railroad freight car truck bolster was performed. The method of analysis incorporated finite-element static stress analysis, rainflow counting technique, and cumulative damage theory. Design improvements were brought about through deformation analysis and the final design reanalyzed with the fatigue process.

81-1439

Noise Impact Inventory of Elevated Structures in U.S. Urban Rail Rapid Transit Systems

Bolt, Beranek and Newman, Inc., Cambridge, MA, Rept. No. DOT-TSC-UMTA-80-29, UMTA-MA-06-0099-80-5, 199 pp (Sept 1980)

PB81-120958

Key Words: Rapid transit railways, Elevated railroads, Noise reduction

This report presents the results of the third task of a five-task program dealing with the reduction of noise from elevated structures in use in U.S. rail rapid transit systems. This report is an inventory and impact assessment of the noise radiated by trains passing on these structures, insofar as this noise is experienced by nearby community residents. An overview is provided of the noise contributions from the various types of structures in nine existing or planned U.S. transit systems. These structures are classified into 17 different categories, and noise-emission characteristics are determined for each type, based on field measurements and/or published data. Day-night average sound levels are estimated for wayside locations near the elevated structures, and population data are used to evaluate noise impact in terms of the Sound Level Weighted Population.

SHIPS

(See No. 1532)

AIRCRAFT

(Also see Nos. 1413, 1414, 1505, 1547, 1568)

81-1440

The Changing Scene of Structural Airworthiness

W.G. Heath

British Aerospace Aircraft Group, Weybridge, UK, Pres. at the 14th Intl. AAAF Aeronautical Congr. on New Develop. in Struct. and Mater., Paris, June 1979, Rept. No. AAAF-NT-79-24; ISBN-2-7170-0572-2, 29 pp (1979)

N81-12076

Key Words: Aircraft, Dynamic response, Fatigue life, Composite materials

The state of the art and the development history of aircraft structures reliability design are reviewed, partly as they are mirrored in official requirements, and partly as they are seen by workers in the field. Included are loading and stress calculations, aeroelasticity, dynamic response, the fatigue problem, and the utilization of composite materials are discussed.

81-1441

Calculation of the Transient Motion of Elastic Airfoils Forced by Control Surface Motion and Gusts

A.V. Balakrishnan and J.W. Edwards

NASA, Hugh L. Dryden Flight Res. Ctr., Edwards, CA, Rept. No. NASA-TM-81351, H-1125, 167 pp (Aug 1980)

N80-32329/8

Key Words: Airfoils, Transient response, Wind-induced excitation

The time-domain equations of motion of elastic airfoil sections forced by control surface motions and gusts were developed for the case of incompressible flow. Extensive use was made of special functions related to the inverse transform of Theodorsen's function. A numerical solution technique for the solution of the general case is given. Examples of the exact transient response of an airfoil are presented.

81-1442

Theoretical Determination of Subsonic Oscillatory Airforce Coefficients for Fin-Tailplane Configurations

D.E. Davies

Royal Aircraft Establishment, Farnborough, UK,

Rept. No. RAE-TR-79125, RAE-STRUCT-BF/B/0794, 237 pp (Sept 1979)
N81-10016

Key Words: Aircraft, Aerodynamic characteristics

Linearized equations of potential flow are solved numerically for the loadings for oscillation at general frequency in any antisymmetric modes, and the generalized aerodynamic coefficients obtained. Approximation to the loadings are taken as linear combinations of basis functions. The condition satisfied by the loadings at the junction of the fin and half tailplanes is imposed on the approximations and the variational principle of Flax is applied to get the coefficients in the said linear combinations. Results obtained using the program on a number of examples are given.

81-1443

Noise Levels and Data Correction Analysis for Seven General Aviation Propeller Aircraft

D.W. Ford and E.J. Rickley

Office of Environment and Energy, Federal Aviation Admn., Washington, D.C., Rept. No. FAA/EE-80-26, 376 pp (Sept 1980)
AD-A091 292/3

Key Words: Aircraft noise, Noise measurement

This document reports noise levels of a general aviation propeller aircraft noise test. The test was performed to acquire noise data on general aviation type aircraft and examine how these noise levels are influenced by variables such as distance, aircraft speed, power settings, and propeller speeds. Aircraft were tested during takeoff, approach, and flyover modes and data are given in EPNL and in 'A'-weighted decibels. All measurements were performed in accordance with FAR 36 Appendix C and Appendix F procedures.

81-1444

Survey Population Response to Airplane Noise, Part 1

C. Bitter and K.W. Schwager

NASA, Washington, D.C., Rept. No. NASA-TM-75790, REPT-D-19, 71 pp (May 1980)
N81-10576

Key Words: Aircraft noise, Human response

A questionnaire concerning aircraft noise is presented. The tabulated responses to it are also presented.

81-1445

Weapon Bay Cavity Noise Environments, Data Correlation and Prediction for the B-1 Aircraft

A.G. Tipton

North American Aircraft Div., Rockwell International, El Segundo, CA, Rept. No. NA-80-247, AFWAL-TR-80-3050, 239 pp (June 1980)
AD-A089 770/2

Key Words: Aircraft, Cavitation noise, Noise reduction, Noise measurement

During development of the B-1 aircraft, an extensive cavity noise measurement and noise reduction program using wind tunnel models and evaluation on a flight-test aircraft was conducted. Substantial cavity noise reduction was achieved with retrofitted spoilers for a mach 0.6 to 1 range for the weapon bay cavity of L/D = 2.2. A substantial amount of cavity unsuppressed and suppressed data were acquired from wind tunnel models and the full-scale aircraft. Data for weapon bay cavities with internal stores and multiple open cavities was also obtained. The data are correlated with existing prediction techniques and modifications to the current prediction techniques, and guidelines are recommended.

81-1446

Flap Noise Characteristics Measured by Pressure Cross-Correlation Techniques

W.R. Miller

Ph.D. Thesis, Univ. of California, Los Angeles, 289 pp (1980)
UM 8104022

Key Words: Aircraft noise, Noise measurement, Cross correlation technique

The aerodynamic sound generated by a realistic aircraft flap system has been investigated through the use of cross-correlations between surface pressure fluctuations and far-field sound. Measurements were conducted in two subsonic wind tunnel studies to determine the strength, distribution, and directivity of the major sources of flap noise at speeds up to 79.0 m/sec. A pilot study was performed on a single flap model to test the measurement technique and provide initial data on the characteristics of flap noise. The major portion of this investigation studied the sound radiated by a realistic large scale model of a triple slotted flap system mounted on a sweptback 6.7 meter semispan model wing.

81-1447

Control of Jet Engine Noise

M.I. Schiff

Industrial Acoustics Co., Inc., Bronx, NY, S/V, Sound Vib., 15 (2), pp 8-12 (Feb 1981) 16 figs

Key Words: Aircraft noise, Jet engines, Engine noise, Noise control

A review covering more than two decades of experience in the design and manufacture of jet engine noise suppression equipment. The development of this equipment for aircraft and test stand applications is traced. Some of the more significant noise control systems are illustrated. Examples of how the interaction of acoustics, aerodynamics, and mechanical performance impacts the operation and service life of jet engine noise suppression equipment are included.

81-1448
Direct Fourier Synthesis of Waves: Application to Acoustic Source Radiation

S.M. Candel and C. Crance

Office National d'Etudes et de Recherches Aerospatiales, Chatillon, France, AIAA J., 19 (3), pp 290-295 (Mar 1981) 8 figs, 15 refs

Key Words: Sound waves, Jet engines, Fourier transformation

In numerous situations of current interest in aeroacoustics the sound field propagates in a nonhomogeneous medium. This is typically the case of jet noise radiation. A widely used model in that situation consists of a thin vortex sheet separating two uniformly moving fluids. This model may be treated as a layered medium, and acoustic source radiation may be analyzed by Fourier transform techniques. The inversion of the Fourier solution is, however, difficult and requires far-field approximations. This difficulty is here avoided by constructing the wave field by direct Fourier synthesis. This method was shown in a previous work to be fast, reliable, and superior to the standard approximations. It is applied here to source radiation in the vicinity of a vortex sheet separating uniformly moving streams. Complete wave field maps are given for subsonic and supersonic flow combinations, providing new insights on jet noise radiation and refraction in open wind tunnels.

81-1449
Noise Suppressors for Jet Engine Testing

M. Lepor

Naval Ocean Systems Ctr., San Diego, CA, ASME Paper No. 80-ENAs-28

Key Words: Jet engines, Jet noise, Noise reduction

Noise control is one of the factors associated with post-maintenance jet engine ground run-up operations. Abatement alternatives currently being considered include modification of existing water-cooled test cells, the introduction of air-cooled noise suppression systems, and technology advancements on cost-effective noise emission control techniques.

81-1450
Effect of a Semi-Annular Thermal Acoustic Shield on Jet Exhaust Noise

J. Goodykoontz

NASA, Lewis Res. Ctr., Cleveland, OH, Rept. No. NASA-TM-81615, E-616, 21 pp (Nov 21, 1980) N81-11770

Key Words: Jet noise, Nozzles, Noise reduction

Reductions in jet exhaust noise obtained by the use of an annular thermal acoustic shield consisting of a high temperature, low velocity gas stream surrounding a high velocity central jet exhaust appear to be limited by multiple reflections. The effect of a semi-annular shield on jet exhaust noise was investigated with the rationale that such a configuration would eliminate or reduce the multiple reflection mechanism. Noise measurements for a 10 cm conical nozzle with a semi-annular acoustic shield are presented in terms of lossless free field data at various angular locations with respect to the nozzle. Measurements were made on both the shielded and unshielded sides of the nozzle. The results are presented parametrically, showing the effects of various shield and central system velocities and temperatures. Selected results are scaled up to a typical full scale engine size to determine the perceived noise level reductions.

81-1451
Core Noise Measurements from a Small, General Aviation Turbofan Engine

M. Reshotko and A. Karchmer

NASA, Lewis Res. Ctr., Cleveland, OH, Rept. No. NASA-TM-81610, E-607, 28 pp (Nov 21, 1980) Presented at the 100th Meeting of the Acoust. Soc. of Amer., Los Angeles, Nov 17-21, 1980 N81-11769

Key Words: Turbofan engines, Noise measurement

As part of a program to investigate combustor and other core noises, simultaneous measurements of internal fluctuating pressure and far field noise were made with a JT15D turbofan engine. Acoustic waveguide probes, located in the engine at the combustor, at the turbine exit and in the core

nozzle wall, were used to measure internal fluctuating pressures. The results obtained from the JT15D engine were compared with those obtained previously from a YF102 engine, both engines having reverse flow annular combustors and being in the same size class.

81-1452
Design for Active and Passive Flutter Suppression and Gust Alleviation

M. Karpel
Ph.D. Thesis, Stanford Univ., 117 pp (1980)
UM 8103527

Key Words: Aircraft, Flutter, Active flutter control, Vibration control

Analytical design techniques for active and passive control of aeroelastic systems are presented. These techniques are based on a rational approximation of the unsteady aerodynamic loads in the entire Laplace domain, which yields matrix equations of motion with constant coefficients. Some existing rational approximation schemes are reviewed, the matrix Pade approximant is modified, and a new technique which yields a minimal number of augmented states for a desired accuracy is presented. Structural modifications are formulated in a way which enables the treatment of passive flutter-suppression means with the same procedures by which active systems are designed.

81-1453
Estimation of Wing Nonlinear Aerodynamic Characteristics at Supersonic Speeds

H.W. Carlson and R.J. Mack
NASA, Langley Res. Ctr., Hampton, VA, Rept. No. NASA-TP-1718, L-13589, 84 pp (Nov 1980)
N81-10004

Key Words: Aircraft wings, Aerodynamic characteristics, Supersonic aircraft, Computer programs

A computational system for estimation of nonlinear aerodynamic characteristics of wings at supersonic speeds was developed and was incorporated in a computer program. This corrected linearized theory method accounts for nonlinearities in the variation of basic pressure loadings with local surface slopes, predicts the degree of attainment of theoretical leading edge thrust, and provides an estimate of detached leading edge vortex loadings that result when the theoretical thrust forces are not fully realized.

81-1454
Optimal Design Studies on Composite Wings with Static and Dynamic Constraints

V.B. Venkayya, T. Harris, and N.S. Khot
Air Force Flight Dynamics Lab., Wright-Patterson AFB, OH, Pres. at the 14th Intl. AAAF Aeron. Congr. on New Dev. in Struct. Mat., Paris, June, 1979, Rept. No. AAAF-NT-79-29; ISBN-2-7170-0577-3, 43 pp (1979)
N81-12077

Key Words: Aircraft wings, Composite materials, Optimum design, Computer programs

Design studies on composite lifting surfaces using two computer programs are described. These programs are based on the displacement method of finite element analysis and serve to optimize structures for minimum weight with given strength and gage requirements. The method includes the study of the sensitivity of the flutter speed to change in frequency and the development of the optimization algorithms from frequency considerations. An analysis of failure criteria and optimization at element and play level is also included. A design example is presented.

81-1455
Dynamics of Longitudinal Motion of a Variable-Sweepback Aeroplane with a Deformable Control System

Z. Dzygadlo
Polish Academy of Sciences, Institute of Fundamental Technological Research, Warszawa, Poland, J. Tech. Phys., 21 (2), pp 209-224 (1980) 13 figs, 10 refs

Key Words: Aircraft, Longitudinal response, Computer programs

The present paper is devoted to the dynamical analysis of the longitudinal motion of the aeroplane during the sweepback change process, taking into consideration the deformability of the elevator controls. Uncontrolled and controlled motion will be considered, introducing elasticity and damping in the control system. A program was written for numerical integration of the equations, using the Runge-Kutta-Gill method. Parameters of motion have been established from a numerical analysis of the influence of elastic and damping properties of the control system on the character and the magnitude of the perturbations.

81-1456

Dynamic Response of a Forward-Swept-Wing Model at Angles of Attack up to 15 DEG at a MACH Number of 0.8

R.V. Doggett, Jr. and R.H. Ricketts

NASA, Langley Res. Ctr., Hampton, VA, Rept. No. NASA-TM-81863; L-13872, 31 pp (Nov 1980)

N81-12448

Key Words: Aircraft wings, Flexural vibration

Root mean square (rms) bending moments for a dynamically scaled, aeroelastic wing of a proposed forward swept wing, flight demonstrator airplane are presented. In addition to broad band responses, individual rms responses and total damping ratios are presented for the first two natural modes.

81-1457

Report on a Cooperative Programme on Active Flutter Suppression

AGARD, Neuilly-Sur-Seine, France, Rept. No. AGARD-R-689; ISBN-92-835-0270-2, 55 pp (Aug 1980)

N81-12115

Key Words: Aircraft, Wing stores, Active flutter control

The results of a cooperative program on active flutter suppression on a dynamic model of the YF-17 aircraft are presented. Control laws for active flutter suppression were derived for one explosive wing-store flutter case of the model. Phase control laws were all tested and compared during wind tunnel tests performed in the Langley 16 ft wind tunnel. Results were quite promising and open the way for future cooperation on full-scale aircraft.

81-1458

Wind Tunnel Test of a Fighter Aircraft Wing/Store Flutter Suppression System: An International Effort

C. Hwang, E.H. Johnson, G.R. Mills, T.E. Noll, and M.G. Farmer

NASA, Langley Res. Ctr., Hampton, VA, In: AGARD Rept. on a Coop. Programme on Active Flutter Suppression, 23 pp (Aug 1980)

N81-12116

Key Words: Aircraft, Wing stores, Active flutter control, Wind tunnel testing, Wind tunnel test data

A 30% scale, half span model of a lightweight fighter aircraft with an active wing/store flutter suppression system was tested in the NASA Langley Research Center sixteen foot transonic dynamics tunnel. The test featured a store configuration that was intentionally designed to exhibit a violent flutter condition. In addition to Northrop organized control laws, three European countries also contributed control laws to stabilize this condition. After the control laws were mechanized by Northrop, they were tested at the Langley facility.

81-1459

Active Control of an Explosive Wing-Store Flutter Case

H. Honlinger, O. Sensburg, M. Kuhn, and H. Godel

Airplane Div., Messerschmidt-Boelkow GmbH., Munich, West Germany, AGARD Rept. on Coop. Programme on Active Flutter Suppress, 8 pp (Aug 1980)

N81-12117

Key Words: Aircraft, Wing stores, Active flutter control

Control laws were calculated, using optimal control theory, to suppress an explosive wing-store flutter case on a YF-17 dynamically scaled model. The trailing edge flap was used for flutter suppression because usually hydraulically driven ailerons are available in modern fighters. The design aim of 1.5 times the flutter dynamic pressure was demonstrated during the wind tunnel test. It is shown that no changes to the analytically developed control law were necessary in the test which proves that theory has well advanced during the last years.

81-1460

Test and Analyses of an Active Flutter Suppression System on an FFDL Model of YF-17

R. Destuynder

Office National d'Etudes et de Recherches Aerospatiales, Leclerc, France, AGARD Rept. on Coop. Programme on Active Flutter Suppression, 8 pp (Aug 1980)

N81-12118

(In French, English summary)

Key Words: Aircraft, Wing stores, Active flutter control

A flutter control law was calculated for a YF-17 model equipped with a store at the wingtip. The control law used stiffness injection on the wing by the help of the unsteady

aerodynamic forces induced by a control surface. The leading edge control surface and only one accelerometer, located in the wing close to the nodal line of the pitching mode of the external store, were used. During the wind tunnel tests the nominal control law was used without considering the existing differences between eigen modes and frequencies introduced in the calculations and eigen modes and frequencies existing on the model itself when mounted in the wind tunnel.

81-1461
Stochastic Modeling of an Aircraft Traversing a Runway Using Time Series Analysis

C. Venkatesan and V. Krishnan
Indian Inst. of Science, Bangalore, India, J. Aircraft, 18 (2), pp 115-120 (Feb 1981) 13 figs, 4 tables, 9 refs

Key Words: Aircraft, Stochastic processes, Runway roughness

Time series, from a narrow point of view, is a sequence of observations on a stochastic process made at discrete and equally spaced time intervals. Its future behavior can be predicted by identifying, fitting, and confirming a mathematical model. In this paper, time series analysis is applied to problems concerning runway-induced vibrations of an aircraft. A simple mathematical model based on this technique is fitted to obtain the impulse response coefficients of an aircraft system considered as a whole for a particular type of operation. Using this model, the output which is the aircraft response can be obtained with lesser computation time for any runway profile as the input.

81-1462
Longitudinal Instability in Braked Landing Gear

R.R. Allen and R.C. O'Massey
Univ. of California, Los Angeles, CA, ASME Paper No. 80-WA/DSC-12

Key Words: Aircraft, Landing gear, Braking effects, Longitudinal vibration

An instability in the form of a self-excited, bounded longitudinal oscillation may occur in aircraft landing gear when one or more wheels lock due to excessive braking. The instability usually appears at ground speeds below 40 knots (20 m/s) and results from interaction between structural elasticity and the nonlinear characteristics of tire-runway friction. A nonlinear mathematical model is developed to study the dynamics of this divergence in a braked, dual tire landing gear. The effect of design variables on longitudinal stability is evaluated and design guidelines are presented which ensure reduction of the severity of this divergent dynamic behavior.

81-1463
Application of the Finite Element Method to Rotary-Wing Aeroelasticity

F.K. Straub
Ph.D. Thesis, Univ. of California, Los Angeles, 237 pp (1980)
UM 8104040

Key Words: Rotary wings, Finite element technique, Aeroelasticity, Galerkin method

A finite element method for the spatial discretization of the dynamic equations of equilibrium governing rotary-wing aeroelastic problems is presented. The equations of motion are nonself-adjoint, nonlinear, and in partial differential form. For this class of problems, variational principles are not available. Thus, formulation of the finite element equations is based on weighted Galerkin residuals. The numerical simulations of the flap-lag problem show the Galerkin finite element method to be a practical tool. The results indicate that the trimmed flap-lag problem is basically stable. Nonlinear effects and higher harmonic contributions are important for both stability and response, in particular, at high advance ratios and more so for flap than for lag. Inclusion of two modes for each elastic degree of freedom is necessary to reliably determine the blade response.

81-1464
Temporal Sampling Requirements for Estimation of Long-Term Average Sound Levels in the Vicinity of Airports

P.D. Schomer and R.E. DeVor
U.S. Army Corps of Engineers, Construction Engrg. Res. Lab., Champaign, IL 61820, J. Acoust. Soc. Amer., 69 (3), pp 713-719 (Mar 1981) 4 figs, 2 tables, 7 refs

Key Words: Airports, Noise measurement

Community noise temporal sampling requirements in general, and in the vicinity of airports or other large noise producers are studied.

MISSILES AND SPACECRAFT

81-1465

Spacecraft Structural Acoustic Studies. Investigation, Interpretation, and Simulation of the Effects of Configuration Features on Noise. Induced Structural Vibration and Sound Transmission Characteristics

R.J. Cummins and I. Gray

British Aerospace Aircraft Group, Bristol, UK, Rept. No. BAe-ESA/B44/40013; ESA-CR(P)-1366, 181 pp (May 1980)

N81-12472

Key Words: Spacecraft, Acoustic excitation, Sound transmission, Computer programs

Broad band acoustic excitation tests were performed on various satellite structural configurations. Limited tests were also performed for narrow band acoustic noise excitation and for random and sine sweep mechanical excitation. Test data were used to assess prediction methods, in particular a statistical energy analysis method implemented in a computer program GENSTEP (General Statistical Energy Program) which predicts the response of a structural configuration including acoustics cavities. The GENSTEP program was updated and the prediction technique was investigated. The modal density of honeycomb panels was studied and an empirical technique devised to evaluate sound transmission of a stiffened cylinder at low frequencies. Theory describing the power input from a mechanical source is evaluated. The response to broad band excitation is compared to the predicted responses for two configurations. There is good agreement between the values.

81-1466

Evaluation of Space Shuttle Main Engine Fluid Dynamic Frequency Response Characteristics

T.G. Gardner

Scientific Services and Systems Group, Wyle Labs., Inc., Huntsville, AL, Rept. No. NASA-CR-161614; Wyle-TM-80-8, 144 pp (Oct 1980)

N81-13087

Key Words: Space shuttles, Liquid propellant rocket engines, Frequency response, Computer programs

In order to determine the POGO stability characteristics of the space shuttle main engine liquid oxygen (LOX) system, the fluid dynamic frequency response functions between elements in the SSME LOX system was evaluated, both analytically and experimentally. For the experimental data evaluation, a software package was written for the Hewlett-Packard 5451C Fourier analyzer. The POGO analysis software is documented and consists of five separate segments. Each segment is stored on the 5451C disc as an individual program and performs its own unique function. Two separate data reduction methods, a signal calibration, coherence or pulser signal based frequency response function blanking, and automatic plotting features are included in the program.

81-1467

Mechanical Noise Suppressor for Small Rocket Motors

C.R. Bishop

Dept. of the Army, Washington, D.C., Rept. No. AD-D007 797/4, 5 pp (Sept 1980)

PAT-APPL-6-183 604

Key Words: Rocket motors, Noise reduction

This invention relates to a noise suppressor for small rocket motors including a plurality of perforated metal cylinders disposed in concentric relation and secured to a support plate. A noise suppression material is disposed in the chamber of each adjacent cylinder. Noise suppression material is also disposed in the center cylinder and is expelled by the rocket motor thrust. A collar on the support plate secures the motor to the suppressor.

BIOLOGICAL SYSTEMS

HUMAN

(Also see No. 1573)

81-1468

Review of Literature and Regulation Relating to Head Impact Tolerance and Injury Criteria. Appendix C. NCSS (National Crash Severity Study) Head Injury Accident Data

R.L. Hess

Highway Safety Res. Inst., Michigan Univ., Ann Arbor, MI, Rept. No. UM-HSRI-80-52-2, 231 pp (July 1980)

PB81-123119

Key Words: Human response, Head (anatomy), Collision research (automotive)

Illustrations of head injury accident data from the NCSS file are presented, correlations between AIS and various measures of crash severity are calculated, and suggestions for improving accident data collection are made.

81-1469
Continuous Miner Noise
J. Robertson, J. Kovac, and R. Bartholomae
Wyle Labs., Huntsville, AL, ASME Paper No. 80-WA/NC-4

Key Words: Mines (excavations), Noise generation, Human response

Noise generated by continuous miners in underground coal production is an important health hazard. Investigation and control of the noise through laboratory tests of simulated cutting operations and through in-mine noise measurements are the subjects of this report. The results of these investigations indicate that coal cutting noise and conveyor noise are dominant sources of miner operational noise.

MECHANICAL COMPONENTS

ABSORBERS AND ISOLATORS
(Also see No. 1528)

81-1470
Energy Efficient Muffler for Reduction of Exhaust Noise Generated by a Pneumatic Grinder
H.A. Scarton, W.C. Kennedy, C.R. Caplan, and K.R. Gaylo
Rensselaer Polytechnic Inst., Troy, NY, ASME Paper No. 80-WA/NC-9

Key Words: Mufflers, Noise reduction, Pneumatic equipment

A summary of work on exhaust noise analysis and noise control of a 15,000 rpm pneumatic horizontal grinder is presented. The result of recent improvements relative to the most silenced original equipment muffler is a reduction in free running noise level of 3.5 dBA to 86 ± 1 dBA measured at 24 in. (61 cm) in a small room with reverberant walls.

81-1471
Insertion Loss Measurements of an Elliptical Cross-Section Dissipation Muffler
M.W. Ferralli
Lord Corp., 2000 W. Grandview Blvd., Erie, PA 16512, Noise Control Engrg., 16 (1), pp 22-24 (Jan/Feb 1981) 5 figs, 9 refs

Key Words: Mufflers, Ducts, Noise reduction, Geometric effects

Insertion loss of an elliptical cross-section dissipative muffler is examined. The muffler is experimentally measured and shown to be superior to a duplicate non-dissipative reference. It is argued and demonstrated that the performance increase is due to discrete placement of the absorber and duct in the silencer, namely, at the respective foci of the cross-section.

81-1472
Noise Reduction in Engine Exhaust
T.R. Norris
Dept. of the Army, Washington, D.C., Rept. No. AD-D007 636/4, 8 pp (June 16, 1980)
PAT-APPL-6-159 730

Key Words: Engine noise, Noise reduction, Mufflers

A noise reduction mechanism for an engine, especially effective during idling and operation at low RPM, is disclosed. Under those conditions, engine exhaust noise often represents a predominant part of the total vehicle noise.

81-1473
Energy Management Damper
R.W. Siorek and J.P. Theuerkauf
Dept. of the Army, Washington, D.C., PAT-APPL-6-171 872, 13 pp (July 1980)
AD-D007 809/7

Key Words: Shock absorbers, Design techniques

A conventional shock absorber is modified by adding a valve cage to the rod end and providing an additional cylinder outside the shock absorber to form an annular reservoir outside the shock absorber. Temperature sensitive valves open when oil heats to a potentially destructive level, unloading the shock absorber. When the oil cools to a safe operating temperature, the temperature sensitive valves re-close and the shock absorber is again operative.

81-1474

Temperature Sensitive Dynamic Cushioning Function Development and Validation for AIRCAP Cellular Polyethylene

R.M. Wyskida and J.D. Johannes

Dept. of Electrical Engrg., Alabama Univ., Huntsville, AL, Rept. No. UAH-RR-257, DRSMI/RL-CR-80-5, 195 pp (Sept 1980)

AD-A091 604/9

Key Words: Packaging materials, Polymers

This report describes the development of cushioning models for the AIRCAP cushioning material. The development models have been statistically validated and are available for use on the HP-9815A desktop calculator, or on a FORTRAN language computer. The temperature range of applicability is 32 F to 160 F and a static stress range of 0.03 to 0.80 psi.

SPRINGS

81-1475

Influence of Flexible Connections on Response Characteristics of a Beam

R. Fossman and A. Sorensen, Jr.

Dresser Industries, Inc., Waukesha, WI 53187, J. Mech. Des., Trans. ASME, 102 (4), pp 829-834 (Oct 1980) 10 figs, 4 tables, 7 refs

Key Words: Supports, Springs, Beams

The natural frequencies and normal modes of a uniform beam depend upon support conditions. The effect of translation and rotation springs at the base is examined in this presentation. This is done in terms of non-dimensional variables and parameters to enhance the utility of the results. The paper also develops the mode participation and dynamic load factors for subsequent application.

TIRES AND WHEELS

(Also see No. 1541)

81-1476

Theoretical and Experimental Studies on the Dynamic Properties of Tyres. Part 1: Review of Theories of Rubber Friction

H. Sakai

Japan Automobile Res. Inst., Ibaraki, Japan, Intl. J. Vehicle Des., 2 (1), pp 78-110 (Feb 1981) 23 figs, 41 refs

Key Words: Tires, Pneumatic tires, Cornering effects, Braking effects, Friction

Previous theoretical work on the dynamic properties of tires is reviewed. Extensions of a theory relating tire cornering properties to conditions of braking and traction are considered, along with factors relevant to a further extension to the dynamic properties of an actual pneumatic tire. A theoretical derivation of the six components of force and moment generated in a tire is given which involves integrating the vertical and friction forces acting on a rubber block and the resultant moments over the area of contact.

BLADES

(Also see No. 1533)

81-1477

Steady and Unsteady Flow in Cascades by a Finite Element Method

D.W. Whitehead

Dept. of Engrg., Cambridge Univ., UK, Rept. No. CUED/A-Turbo/TR-99, 23 pp (Apr 1980)

N81-13028

Key Words: Cascades, Blades, Finite element technique, Computer programs, Translational response, Torsional response, Force coefficients, Moment coefficients

A computer program generates the mesh, calculates the steady flow through the cascade, and calculates unsteady pressure distributions, force coefficients and moment coefficients due to translational and torsional motion of the blades. The program is limited to subsonic inlet and outlet flow, although it can deal with patches of supersonic flow over the blade surface. Since it assumes potential flow it cannot deal with wakes coming from upstream and with shock waves. Flow round the leading edges of thick blades is correctly handled, and the program also allows for acoustic waves propagated upstream and downstream.

81-1478

Force and Moment Coefficients for High Deflection Cascades

D.S. Whitehead and R.J. Grant

Dept. of Engrg., Cambridge Univ., UK, Rept. No. CUED/A-Turbo/TR-98; ISSN-0309-6521, 42 pp (May 1980)
N80-13021

Key Words: Turbine blades, Blades, Force coefficients, Moment coefficients, Finite element technique

The development of a computer program for the prediction of force and moment coefficients for the vibration of compressor and turbine blades having a large amount of deflection of the mean flow, using a finite element approach, is described. The program is limited to subsonic inlet and outlet flows (but can deal with local supersonic patches) and to flow without inlet vorticity and without shock waves. Results for the moment coefficients on a turbine cascade show good agreement with experiment.

81-1479

Whistling Instability in Idling Circular Saws

C.D. Mote, Jr. and M.C. Leu
Univ. of California, Berkeley, CA, ASME Paper No. 79-WA/DSC-18

Key Words: Saws, Circular saws, Self-excited vibrations

Whistling is a self-excited transverse instability that produces intense noise at a resonance frequency of a circular saw. Experiments were undertaken to examine the noise source dependence upon tooth shape, tooth number, rotation speed and the surrounding air pressures. The source model supported by the data is a self-excited fluid-structure instability possibility with a wake oscillation sustained or enhanced by the blade motion.

BEARINGS

(Also see No. 1406)

81-1480

A Rapid Determination of Journal Bearing Characteristics under Combined Loading

J. Modrey and Y.K. Younes
Purdue Univ., Lafayette, IN, ASME Paper No. 80-DET-62

Key Words: Bearings, Journal bearings

Currently the most reliable solution of the Reynolds equation for journal bearings under combined precessive and radial squeeze motions with film cavitation is by Gauss Seidal iteration. An alternate direct method of solution based on the Thomas algorithm and Richardson extrapolation is described.

81-1481

Dynamic Stability of Externally Pressurized Gas Bearings

E. Blondeel, R. Snoeys, and L. Devrieze
Katholieke Universiteit Leuven, Department Werktuigkunde, Afdeling Werkplaatstechniek and Industrieel Beleid, Celestijnenlaan, 300B, B-3030 Heverlee, Belgium, J. Lubric. Tech., Trans. ASME, 102 (4), pp 511-519 (Oct 1980) 11 figs, 15 refs

Key Words: Bearings, Gas bearings, Self-excited vibrations

A feedback loop model is presented to study instability phenomena in externally pressurized gas bearings. The main features in the theoretical analysis are the compressibility of the fluid and molecular transit times in the bearing gap. The proposed theory is based upon a separate handling of disturbances due to gap thickness variations and pressure changes. The analysis shows that the dynamic pressure distribution in the gap plays an important role in the overall bearing stability. Comparisons between theoretical and experimental observations are highlighted; reference is made to Turnblade's stability chart. The proposed analysis gives some additional information with regard to the relative importance of some bearing parameters.

81-1482

Wear of Dynamically Loaded Hydrodynamic Bearings by Contaminant Particles

A. Ronen, S. Malkin, and K. Loewy
Technion - Israel Inst. of Tech., Haifa, Israel, J. Lubric. Tech., Trans. ASME, 102 (4), pp 452-458 (Oct 1980) 10 figs, 3 tables, 10 refs

Key Words: Bearings, Hydrodynamic bearings, Wear

An investigation is reported on the wear of hydrodynamic bearings by contaminant particles in the oil under dynamic loading conditions. A test bearing rig was developed to dynamically simulate an automotive connecting rod engine bearing, and the contaminant additions were of the types normally used for testing of automotive oil filters and air cleaners. Shaft and linear wear for clean and contaminated oil were measured both in terms of dimensional changes and weight loss at two different rotating speeds. As compared

with clean oil, both shaft and linear wear were found to increase by typically a factor of 20 when running with the contaminated oil. A direct correlation was found between the local oil film thickness history and wear intensity for both the clean and contaminated oil. The wear tended to increase steeply at those locations where the oil film was smaller for a greater portion of the operating cycle.

FASTENERS

81-1483
Resonant Impedance of Bellows Above Cutoff

S. Krinsky
Brookhaven National Lab., Upton, NY, Rept. No. CONF-800740-5, 5 pp (1980)
BNL-28004

Key Words: Bellows, Mechanical impedance, Resonant frequencies

The perturbation method of Chatard-Moulin and Papiernik is used to calculate the longitudinal and transverse impedances. A finite wall conductivity is considered and the resonant contribution to the impedance above the cutoff frequency of the unperturbed chamber is determined, obtaining analytic approximations to the resonant frequencies, quality factors, and shunt impedances.

LINKAGES

81-1484
The Finite Element Analysis of Flexible Components of Mechanical Systems Using a Mixed Variational Principle

M.V. Gandhi and B.S. Thompson
Wayne State Univ., Detroit, MI, ASME Paper No. 80-DET-64

Key Words: Linkages, Finite element technique, Variational methods

A finite element analysis is presented for determining the deflections and associated stresses in a flexible component of a general planar linkage mechanism. The equations governing this elastodynamic behavior are contained within a mixed variational principle and theory is presented to demonstrate how this variational statement provides the basis for the finite element modeling.

VALVES

81-1485
Studies on the Hydraulic Oscillators (2nd Report, Experimental Analysis)

T. Maeda and S. Konami
Faculty of Engrg., Seikei Univ., Musashino-shi, Japan,
Bull. JSME, 24 (187), pp 117-123 (Jan 1981) 15 figs, 6 refs

Key Words: Valves, Hydraulic valves, Vibration response, Self-excited vibrations, Experimental test data

This paper presents the experimental results and analyses on the vibratory characteristics of the hydraulic oscillator which utilizes the self-excited vibration phenomenon occurring in valves such as a spool valve or a poppet valve. Experiments on the two improved forms of the hydraulic oscillator -- an oscillator with saturation restoring torque and one with reinforced hydraulic restoring torque -- were carried out by systematically varying the factors affecting the vibratory characteristics. The vibratory characteristics having the frequencies in the range of 14 to 85 Hz and the angle amplitudes in the range of 10 to 34 degrees were obtained in this experiment. By comparing the theoretical vibratory characteristics presented in previous report with the experimental ones, it became clear that they almost agreed in the relation of the frequency to the angle amplitude. Available data for the design of the hydraulic oscillator were obtained.

81-1486
A Study of Valve Noise Generation Processes for Compressible Fluids

G.C. Chow and G. Reethof
The Fennsylvania State Univ., University Park, PA,
ASME Paper No. 80-WA/NC-15

Key Words: Valves, Noise generation

An experimental investigation of the valve noise generation mechanisms associated with several valve orificial configurations of both the conventional and quiet valve design type is reported. The investigation was conducted using a schlieren device and a two-dimensional glass sided fixture with compressed air as the working fluid. Both acoustic and flow data were taken for the various models of valves operating below and above critical pressure ratios.

81-1487
Aerodynamic Noise Generation in Control Valves

K.W. Ng

IIT Corp., Providence, RI, ASME Paper No. 80-WA/NC-8

Key Words: Valves, Noise generation, Aerodynamic noise

An experimental investigation on the aerodynamic noise generation from control valves was conducted in a semi-anechoic facility. The noise spectral characteristics of several cage trim valves are presented. In general, broadband shock noise and turbulent mixing noise are the two major aerodynamic noise generation mechanisms. The relative importance of the broadband shock noise and turbulent mixing noise has been shown to be strongly dependent on the valve lift, valve orificial geometries, and operating condition.

81-1488
Response of a 6-Inch Nuclear Power Plant Valve to Dynamic Excitation
S.F. Masri and S.J. Stott
Dept. of Civil Engrg., Univ. of Southern California, Los Angeles, CA, 260 pp (Nov 1980)
NUREG/CR-1644

Key Words: Electric power plants, Nuclear power plants, Valves, Laboratory test data

Experimental laboratory studies of a valve for nuclear power plant application were conducted to determine characteristic structural dynamic response relationships between various magnitudes and types of forced excitation. The forced dynamic excitation consisted of sweptsine, sine dwell, random, and shock base accelerations that were generated by an electrodynamic shaker or a shock machine. For each type of excitation, different magnitudes and directions of acceleration were applied. Acceleration and strain data were recorded on analog tape and subsequently analyzed. Transmissibility ratio, power spectral density, time histories, and shock spectra were determined. The valve was found to have a complicated dynamic response characterized by multiple resonances and nonlinear behavior. This report comprises complete laboratory data obtained from this investigation but does not include analysis. Detailed analysis of the data will follow in future documents.

CAMS

81-1489
On the Periodic Response of Cam Mechanism with Flexible Follower and Camshaft
A. Midha and D.A. Turcic
The Pennsylvania State Univ., Univ. Park, PA, ASME Paper No. 80-WA/DSC-33

Key Words: Cams, Cam followers, Camshafts, Periodic response

Researchers in recent years have shown a great deal of interest in the study of the dynamic response of cam follower systems, with one or more of its components treated as being elastic. Within the assumption of a linear analysis, and limited to stable regions, a single degree-of-freedom linear second order differential equation of motion is developed for a cam mechanism consisting of elastic follower and camshaft.

STRUCTURAL COMPONENTS

STRINGS AND ROPES

81-1490
The Complex Vibrations and Implied Drag of a Long Oceanographic Wire in a Cross-Flow
C.M. Alexander
Ph.D. Thesis, Univ. of California, San Diego, 67 pp (1980)
UM 8103775

Key Words: Wires, Underwater structures, Towed systems, Fluid-induced excitation

A cylinder in cross-flow experiences periodic forcing related to the shedding of vortices in its wake. Long wires in the ocean vibrate in response to this forcing, but their length and damping is such that boundary conditions do not generally apply to solutions of the equations of motion, and their vibratory behavior at one point is of little consequence at remote points. The bulk of previous studies of vibrating wire characteristics have utilized only short wires or cylinders in the laboratory, so have not considered or even permitted this phenomenon. During a typical deployment of the Scripps Deep-Tow survey system to 2800 meters a small 2-axis accelerometer package was attached to the tow wire at a depth of 30 meters and its output recorded in a diver-operated vehicle about 1 meter downstream. Analysis of this data produced sharply peaked spectra with the frequencies of vibration in the direction of flow twice those across the flow. Good correlations were found between mean amplitudes across the flow and the corresponding peak frequencies, and between mean amplitudes across and aligned with the flow. Preference for a specific phase relation be-

tween motions in the two planes suggests that vortex shedding occurs progressively, and forcing has the form of a complex wave traveling down the wire.

CABLES

81-1491
A Representation of Fluid Forces for Use in Finite Segment Cable Models

R.L. Huston and J.E. Kamman
Dept. of Mech. and Industrial Engrg., Cincinnati Univ., OH, Rept. No. UC-MIE-090180-9-ONR, 36 pp (Sept 1, 1980)
AD-A090 181/9

Key Words: Cables (ropes), Fluid-induced excitation

The finite segment modeling of a long flexible cable is discussed. An equivalent force system representing the fluid and gravitational forces exerted on a typical cable segment is determined. The fluid forces include inertia, drag, and hydrostatic (buoyancy) forces. Application of the result in computer algorithm development is also discussed.

BEAMS

(Also see No. 1475)

81-1492
Nonlinear Vibration of Beams in an Axial Force Field

K. Parameswaran, T.K. Varadan, and G. Prathap
Dept. of Computer Science, Indian Inst. of Tech., Madras, India 600036, J. Acoust. Soc. Amer., 69 (3), pp 709-712 (Mar 1981) 5 figs, 3 refs

Key Words: Beams, Axial force, Nonlinear vibrations

The nonlinear vibrational characteristics of beams with variable axial restraint at the boundary, and with an axial force applied at any intermediate station of the beam are studied. The behavior of the system at the time of maximum amplitude is determined by the use of successive integration and iteration scheme. Numerical results are presented for a uniform, simply supported beam, for the cases of movable and immovable hinges. For the case of an immovable hinge, the nonlinearity is always of the hardening type. In the case of a movable hinge, for low values of the imposed axial force, the nonlinearity is of the softening type. But, the softening behavior changes to a hardening one when the axial force approaches the value of the buckling load. When the results are particularized for the linear case, the agreement is very good with those available in the literature.

81-1493
Compressional Damping in Three-Layer Beams Incorporating Nearly Incompressible Viscoelastic Cores

B.E. Douglas
Propulsion and Auxiliary Systems Dept., David W. Taylor Naval Ship Res. and Dev. Ctr., Annapolis, MD, Rept. No. DTNSRDC/PAS-80/26, 25 pp (Oct 1980)
AD-A091 284/0

Key Words: Beams, Layered materials, Viscoelastic core-containing media, Transverse shear deformation effects, Rotatory inertia effects

The transverse free mechanical impedance response of an elastic-viscoelastic-elastic beam incorporating the compressional damping mechanism is considered. The work of Douglas and Yang is extended to include shear deformation and rotary inertia in the elastic layers. The effects of nearly incompressible viscoelastic damping cores on the compressional frequency, and hence on the spectral range of damping effectiveness for the composite, is also discussed. Results of the analysis are shown to compare favorably with experimental results for a damped three-layer beam which was optimized for compressional damping and in which the influence of the shear damping mechanism was intentionally minimized.

CYLINDERS

81-1494
The Effect of Sound on the Vortex-Shedding from a Circular Cylinder (Acoustical Vibrations Directed along Axis of Cylinder)

S. Okamoto, T. Hirose, and T. Adachi
Ishikawagima-Harima Heavy Industries Co., Ltd., Nishitama, Tokyo, Japan, Bull. JSME, 24 (187), pp 45-53 (Jan 1981) 13 figs, 10 refs

Key Words: Cylinders, Circular cylinders

An experimental investigation has been carried out to study acoustic interferences in vortex-shedding from a circular

cylinder in a crossflow subjected to the acoustical vibrations directed along the axis of the cylinder, and in particular, to measure the correlation of vortex-shedding along the cylinder axis. The results indicate that the effects of the acoustical vibrations directed along the axis of the cylinder are similar to the effects of the acoustical vibrations whose direction is normal to the axis of the cylinder on the vortex-shedding from the cylinder, and both vibrations increase the spanwise correlation of the cylinder wake. The acoustic frequencies which produce powerful effects on vortex-shedding correspond to the frequencies of laminar-turbulent transition wave in a separated shear layer, and there are critical sound pressure levels in these acoustical vibrations.

PIPES AND TUBES

81-1495
Steady Impact Vibration of Continuous Elements (Case of Colliding Once in a Half Cycle)

T. Watanabe
Faculty of Education, Yamanashi Univ., Takeda 4-4-37, Kofu, Japan, Bull. JSME, 24 (187), pp 222-228 (Jan 1981) 7 figs, 8 refs

Key Words: Nonlinear vibration, Pipelines, Nuclear power plants, Beams, Clearance effects, Hysteretic damping

This paper deals with the nonlinear vibration problem concerning mechanical equipment-piping systems in nuclear power plants. A simplified dynamical model of these systems consists of an elastic beam with one end fixed and the other end supported by a piecewise-linear spring with clearance and hysteretic damping. Analytical methods of exact and approximate solutions are introduced for the model as a continuous system with nonlinear boundary conditions. Some numerical examples are shown. Finally some numerical results obtained from exact solutions are compared with those from approximate solutions.

81-1496
Numerical Analysis of Pressure and Velocity Distributions for a Pulsating Turbulent Flow in a Circular Tube Containing a Slightly Compressible Fluid

M. Ohmi, S. Kyomen, and T. Usui
Faculty of Engrg., Osaka Univ., Yamada-Kami, Suita, Osaka, Japan, Bull. JSME, 24 (187), pp 60-66 (Jan 1981) 8 figs, 1 table, 8 refs

Key Words: Tubes, Fluid-induced excitation, Method of characteristics, Finite difference technique

Approximate equations for a pulsating turbulent flow in a circular tube containing a slightly compressible fluid are numerically calculated by the method of characteristics and finite difference. Axial distributions of pressures and velocities along the pipe axis and a cross-sectional distribution of velocities are computed by using a time-dependent friction velocity and a time-independent one. Pressure and velocity distributions calculated at various frequencies are shown schematically. Those calculated with a time-dependent friction velocity agree well with experimental ones.

81-1497
On Circular Pipe Wall Vibratory Response Excited by Internal Acoustic Fields

H.T. Loh and G. Reethof
The Pennsylvania State Univ., University Park, PA, ASME Paper No. 80-WA/NC-13

Key Words: Pipes (tubes), Valves, Noise-induced excitation

Internal acoustic fields in pipes as generated by control valves, for example, interact with the pipe walls such that very large drops in transmission loss are experienced at a series of discrete frequencies - the coincidence frequencies. This paper develops the analysis for the calculation of the pipe vibration amplitude at the coincidence frequencies so that the radiation external to the pipe can be estimated. External acoustic loading and material damping are considered.

81-1498
Dynamic Response of a Buried Pipe in a Seismic Environment

S.K. Datta, A.H. Shah, and N. El-Akily
Dept. of Mechanical Engrg., Colorado Univ. at Boulder, CO, Rept. No. CUMER-80-5, NSF/RA-800214, 36 pp (Aug 1980)
PB81-119513

Key Words: Pipes (tubes), Underground structures, Seismic excitation, Shells, Cylindrical shells

Axisymmetric dynamic response of a buried pipe due to an incident compressional wave is the subject of this study. The pipe has been modeled as a thin cylindrical shell of linear homogeneous isotropic elastic material embedded in a linear isotropic homogeneous elastic medium of infinite extent. The response characteristics of the pipe due to changes in the material properties of the surrounding medium have been studied. It was found that even at long wavelengths and low

frequencies the dynamic response is significantly altered by the changes in the Poisson's ratio and the rigidity modulus of the surrounding medium. In addition, it was found that there are real resonant frequencies of the pipe which are also significantly dependent on these quantities as well as on the wavelength.

81-1499
Fluid-Resonator Response to Hydrodynamic Pressure Oscillations

M.L. Pollack
Knolls Atomic Power Lab., Schenectady, NY, Rept. No. CONF-801102-13, 31 pp (Feb 1980) ASME Winter Annual Mtg., Chicago, IL, Nov 16, 1980
KAPL-4121

Key Words: Pipes (tubes), Pipe resonators, Hydrodynamic excitation, Impedance technique

A technique for predicting the one-dimensional acoustic response of a fluid resonator to hydrodynamic pressure excitation by means of an impedance method is presented. The pressure excitation is simulated by virtual pressure sources, and a pipe excited by such sources is presented as a sample case. The dependence of the response on the source distribution (i.e., correlation length) is examined. Further work necessary to extend the analysis capability to include the normal-mode and statistical-turbulence methods is outlined.

81-1500
On the Acoustical Implications of Vortex Shedding from an Exhaust Pipe

S.W. Rienstra
National Aerospace Lab., NLR, Amsterdam, The Netherlands, ASME Paper No. 80-WA/NC-16

Key Words: Exhaust systems, Pipes (tubes), Vortex shedding, Vortex noise

Asymptotic approximations for small Strouhal number are derived for the solution of the problem of the interaction between an acoustic wave and a subsonic jet flow issuing from a semi-infinite pipe. Density and sound speed differences between the jet flow and the (slowly moving) ambient medium, and a general edge condition are included.

81-1501
Passive Acoustic Detection of Gas Leaks in Buried Pipes

A.Soom, H.R. Martin, and J.A. Lea
State Univ. of New York at Buffalo, Buffalo, NY, ASME Paper No. 80-WA/NC-17

Key Words: Pipes (tubes), Underground structures, Acoustic detection, Diagnostic techniques

The feasibility of using microphones to detect sounds generated by small (1.1 to 3.5 mm dia) buried jet-like gas leaks is examined. The main aspects of the problem, namely, the determination of leak-radiated sound power, the attenuation of air waves in sands and soils, and the measurement of ambient sound pressure levels below ground are explored experimentally under laboratory and simulated field conditions.

81-1502
Seismic Analysis of Piping with Nonlinear Supports

D.A. Barta, S.N. Huang, and L.K. Severud
Hanford Engrg. Dev. Lab., Richland, WA, Rept. No. CONF-800804-28, 23 pp (Jan 1980)
HEDL-SA-1994-FP

Key Words: Piping systems, Supports, Seismic analysis

The modeling and results of nonlinear time-history seismic analyses for three sizes of pipelines restrained by mechanical snubbers are presented. Numerous parametric analyses were conducted to obtain sensitivity information which identifies relative importance of the model and analysis ingredients. Special considerations for modeling the pipe clamps and the mechanical snubbers based on experimental characterization data are discussed. Comparisons are also given of seismic responses, loads and pipe stresses predicted by standard response spectra methods and the nonlinear time-history methods.

81-1503
Dispersion Relations of an Elastic Rod Embedded in an Elastic Soil

R. Parnes
Weidlinger Associates, NY, Rept. No. NSF/RA-800211, 29 pp (Feb 1980)
PB81-120404

Key Words: Pipes (tubes), Underground structures, Earthquake response, Resonant response

Failure of buried pipes during earthquakes is believed to be due to resonant or near-resonant behavior under certain prescribed ground motion inputs. For any given wavelength, the resonant frequencies of the system are immediately known once the phase velocities of the system are established. These phase velocities are dependent on the wavelengths of waves propagating in the system and thus reveal the dispersive character of the system. The model considered is represented by an elastic rod of radius 'a' embedded in a linear elastic medium, and the interaction between the surrounding soil and pipe is assumed to occur through a shear mechanism acting at the interface. The problem is then to consider at what velocities a wave of wavelength lambda can propagate under steady state conditions. Results are presented in the form of dispersion curves and surfaces. From a study of the analytical results obtained, lower and upper bounds on the phase velocities are established.

81-1504
The Underwater Jet Noise Rig: A Working Report 1978 to 1979
R.E. Franklin and J. McMillan
Dept. of Engrg. Science, Oxford Univ., UK, Rept. No. OUEL-1310/80, 78 pp (Mar 1980)
N81-10809

Key Words: Underwater sound, Underwater structures, Pipelines

An underwater jet rig was developed and experiments run showing that it can be used to study a wide range of problems. Extraneous low and middle frequency noise which was found to have been transmitted by vibrations of the inlet pipework to the nozzle and has been virtually eliminated by modifications to the rig. The rig can provide accurate and highly repeatable interference-free noise spectra for water jets up to 2 in. dia. and jet speeds up to 67 ft sec, and experiments with jets of three different diameters show that the spectra are consistent with those published by other workers for single phase jets. The high frequency levels of the jet noise spectra, even at high cavitation numbers, are shown to be highly sensitive to the concentration of micro bubbles of air in the water flow. There is evidence that the bubbles may give rise to interference by vibration noise.

DUCTS
(Also see No. 1471)

81-1505
Acoustic Radiation from Axisymmetric Ducts: A Comparison of Theory and Experiment
W.L. Meyer, B.R. Daniel, and B.T. Zinn
Georgia Inst. of Tech., Atlanta, GA, AIAA J., 19 (3), pp 319-323 (Mar 1981) 9 figs, 1 table, 7 refs

Key Words: Ducts, Sound waves, Pipes (tubes), Noise measurement, Noise prediction, Jet engines

A special cylindrically symmetric integral representation of the exterior solutions of the Helmholtz equation is used to calculate the free-field acoustic radiation patterns around two finite axisymmetric bodies, a straight pipe and a jet engine inlet. The radiation patterns around these bodies are then measured experimentally, with the free field being approximated through the use of an anechoic chamber. The inlet tested has a hard wall while the straight pipe is tested with both a hard and a lined wall. The computed theoretical and the measured experimental acoustic radiation patterns are found to be in good agreement. A discussion of possible sources of error, both theoretical and experimental, is included.

81-1506
Numerical Techniques in Linear Duct Acoustics -- A Status Report
K.J. Baumeister
NASA Lewis Res. Ctr., Cleveland, OH, ASME Paper No. 80-WA/NC-2

Key Words: Ducts, Finite difference technique, Finite element technique, Sound propagation, Variable cross section

A review is presented covering both finite difference and finite element analysis of small amplitude (linear) sound propagation in straight and variable area ducts with flow, as might be found in a typical turbojet engine duct, muffler, or industrial ventilation system. Both "steady" state and transient theories are discussed. Emphasis is placed on the advantages and limitations associated with the various numerical techniques.

ELECTRIC COMPONENTS

CONTROLS (SWITCHES, CIRCUIT BREAKERS)
(See Nos. 1548, 1549)

DYNAMIC ENVIRONMENT

ACOUSTIC EXCITATION

(Also see Nos. 1448, 1449, 1472, 1531, 1568, 1569)

81-1507

Kramers-Kronig Relationship Between Ultrasonic Attenuation and Phase Velocity

M. O'Donnell, E.T. Jaynes, and J.G. Miller

Lab. for Ultrasonics, Dept. of Physics, Washington Univ., St. Louis, MO 63130, J. Acoust. Soc. Amer., 69 (3), pp 696-701 (Mar 1981) 5 figs, 14 refs

Key Words: Acoustic absorption, Phase velocity

Kramers-Kronig relations linking the attenuation and dispersion are presented for a linear acoustic system. These expressions are used as a starting point to derive approximate, nearly local expressions relating the ultrasonic attenuation at a specific frequency to the local frequency derivative of the phase velocity (i.e., dispersion). The validity of these approximate relationships is demonstrated in several acoustic systems exhibiting substantially different physical properties.

81-1508

Remarks on the Inverse Scattering Problem for Low Frequency Acoustic Waves

D. Colton

Appl. Mathematics Inst., Delaware Univ., Newark, DE, Rept. No. TR-70A, AFOSR-TR-80-0639, 17 pp (May 15, 1980)

AD-A089 875/9

Key Words: Acoustic waves, Wave diffraction

It is the purpose of this paper to investigate the low frequency inverse scattering problem for 'hard' and 'soft' infinite cylinders and 'soft' obstacles in space and consider the inverse scattering problem in space where the obstacle is 'hard', i.e., the boundary condition is of Neumann type. A basic result of the analysis to date is that the low frequency inverse scattering problem can be stabilized. In the case of domains in the plane this is accomplished by transmitting two plane waves from different directions, where the second plane wave is used to determine the transfinite diameter of the obstacle.

81-1509

Viscous Theory of Surface Noise Interaction Phenomena

J.E. Yates

Aeronautical Res. Associates of Princeton, Inc., NJ, Rept. No. NASA-CR-3331, ARAP-419, 44 pp (Sept 1980)

N80-33176

Key Words: Airfoils, Noise generation, Fluid-induced excitation

A viscous linear surface noise interaction problem is formulated that includes noise production by an oscillating surface, turbulent or vortical interaction with a surface, and scattering of sound by a surface. The importance of viscosity in establishing uniqueness of solution and partitioning of energy into acoustic and vortical modes is discussed. The results of inviscid two dimensional airfoil theory are used to examine the interactive noise problem in the limit of high reduced frequency and small Helmholtz number.

81-1510

Introduction to Design Specification Criteria for Acoustical Insulation

T.A. Dear

E.I. DuPont de Nemours & Co., Wilmington, DE, ASME Paper No. 80-WA/NC-10

Key Words: Acoustic insulation, Design techniques

Acoustical insulation can be an effective tool for noise reduction, particularly on a retrofit basis. There are a large number of materials and configurations that can be used to perform this task. This paper contains references to materials and configurations that have been optimized by standardized laboratory tests. In addition, field experience has been made available to indicate the performance of preferred materials and configurations in industrial environments. A number of basic performance characteristics and environmental factors are discussed to bring what is known by theory and field experience into a summary. It is directed to design engineers who may deal with insulation materials for other purposes (e.g., thermal control).

81-1511

Locally and Nonlocally Reacting Flexible Porous Layers; A Comparison of Acoustical Properties

K.U. Ingard

Massachusetts Inst. of Tech., Cambridge, MA, ASME Paper No. 80-WA/NC-14

Key Words: Layered materials, Porous materials, Acoustic properties

The acoustical properties of a porous layer backed by a rigid wall are studied with particular attention to the difference between locally and nonlocally reacting layers and the role of flexibility of the material. Propagation constant, impedance, reflection and absorption coefficients are discussed as functions of frequency and the angle of incidence. The possibility of using the flexibility of the material for the purpose of creating a low frequency resonance with high absorption without significant loss at high frequencies is explored.

81-1512
Experimental Investigation into the Physics of Arc-Air Metal Gouging Noise Generation

W.C. Kennedy, H.A. Scarton, J.F. McDonald
Gannon Univ., Erie, PA, ASME Paper No. 80-WA/NC-12

Key Words: Noise generation, Noise reduction

The sources of noise produced during arc-air gouging are identified as air noise and arc noise. Arc noise is shown to be the most severe, and to result from repeated quenching of the arc. A novel explanation of the arc-quenching noise generating mechanism which involves the magnetohydrodynamic pinch effect is proposed and verified indirectly on the basis of the noise measurements. The implications of the above results for reducing noise during arc-air gouging are discussed.

81-1513
Fluid-Resonator Response to Hydrodynamic Pressure Oscillations

M.L. Pollack
General Electric Co., Schenectady, NY, ASME Paper No. 80-WA/NC-7

Key Words: Acoustic response, Hydrodynamic excitation, Resonators, Impedance technique

A technique for predicting the one-dimensional acoustic response of a fluid resonator to hydrodynamic pressure excitation by means of an impedance method is presented. The pressure excitation is simulated by virtual pressure sources, and a pipe excited by such sources is presented as a sample case. The dependence of the response on the source distribution (i.e., correlation length) is examined. Further work necessary to extend the analysis capability to include the normal-mode and statistical-turbulence methods is outlined.

81-1514
Attenuation of Acoustic Waves in Lithium Niobate

I.L. Bajak, A. McNab, J. Richter, and C.D.W. Wilkinson
Dept. of Electronics and Electrical Engrg., Univ. of Glasgow, Glasgow, Scotland, J. Acoust. Soc. Amer., 69 (3), pp 689-695 (Mar 1981) 5 figs, 3 tables, 19 refs

Key Words: Acoustic absorption, Elastic waves, Sound waves

The attenuation of acoustic waves in the bulk of $LiNbO_3$ at room temperature has been measured in the frequency range 500 MHz to 10 GHz. The measurement technique involved optical detection at the lower half of the frequency range and high resolution pulse echo method at 9.45 GHz. The attenuation is found to depend on the square of the frequency, so the attenuation coefficient may be given in terms of an effective viscosity value, according to a treatment based on the theory of perturbation. The attenuation coefficient has been determined for various modes and propagation directions allowing the complete determination of the viscosity tensor, from which the attenuation coefficient can be calculated for any desired type of acoustic wave in $LiNbO_3$.

81-1515
Noise Reduction of a Tack Driving Assembly by Design

M.A. Satter
Univ. of Maiduguri, P.M.B. 1069, Borno State, Nigeria, Noise Control Engrg., 16 (1), pp 15-20 (Jan/Feb 1981) 16 figs, 6 refs

Key Words: Noise reduction, Industrial facilities, Machinery noise

Impact noise emission from a tack driving assembly, which is part of a boot and shoe lasting machine, is investigated. Much of the noise is radiated from the tack driver lifting lever which is excited at several of its natural frequencies by direct impacts during the tack driving process. Based on the knowledge of the investigation, several small design

changes have been introduced and have resulted in significant reduction of noise. An experimental approach has been preferred to a more complicated theoretical treatment, since this straightforward approach is appealing to machine designers.

SHOCK EXCITATION

81-1516
Pendulum Tests of Timber Sign Supports
C.E. Kimball and G.W. Deel
Southwest Res. Inst., San Antonio, TX, Rept. No. FHWA/SWRI-80/01, 65 pp (Mar 1980)
PB81-122608

Key Words: Traffic sign structures, Impact tests

The report describes the results of eight pendulum tests on timber poles with four different drilled hole patterns used to reduce the impact resistance of the poles. The pendulum mass weighed 2250 lbs, was equipped with a crushable nose simulating a pre-1974 Chevrolet Vega, and had an impact speed of 20 mph.

81-1517
Inelastic Processes in Seismic Wave Generation by Underground Explosions
H.C. Rodean
Lawrence Livermore Lab., California Univ., Livermore, CA, 94 pp (Aug 1, 1980)
UCRL-84515

Key Words: Explosion effects, Underground explosions, Seismic waves

Theories, computer calculations, and measurements of spherical stress waves from explosions are described and compared, with emphasis on the transition from inelastic to almost-elastic relations between stress and strain. Two aspects of nonspherical explosion geometry are considered: tectonic strain release and surface spall. Tectonic strain release affects the generation of surface waves; spall closure may also. The reduced-displacement potential is a common solution (the equivalent elastic source) of the forward and inverse problems, assuming a spherical source. Measured reduced-displacement potentials are compared with potentials calculated as solutions of the direct and inverse problems; there are significant differences between the results of the two types of calculations and between calculations and measurements.

81-1518
Seismic Response Analysis for Structures with Non-Orthogonal Modes
W.F. Yau
Savannah River Lab., DuPont de Nemours (E.I.) and Co., Aiken, SC, Pres. at ASME Century 2 Emerging Tech. Conf., San Francisco, Aug 10, 1980, Rept. No. DP-MS/79-78; CONF-800804-21, 9 pp (1980)
N81-12290

Key Words: Seismic response, Spectrum analysis

For seismic analysis of structures in nuclear industry, the spectrum method of modal combination is applicable only to systems with orthogonal natural modes. When a structure with frequency dependent boundary conditions is set in motion, its natural modes of vibration are generally non-orthogonal. Based on such a structure, the spectrum method of modal composition is generalized to include systems with nonorthogonal modes. To illustrate the generalized method, the model responses of a simple structure are analyzed in detail.

81-1519
Experiments on the Stability of Converging Cylindrical Shock Waves
J.H.T. Wu, R.A. Neemeh, and P.P. Ostrowski
McGill Univ., Montreal, Canada, AIAA J., 19 (3), pp 257-258 (Mar 1981) 4 figs, 3 refs

Key Words: Shock waves, Shock tube testing

Stability of converging cylindrical shock waves is investigated experimentally in an annular shock tube. Initially symmetric shocks are found to retain their symmetry during implosion except at small radius where a breakdown in shock front curvature eventually occurs. Artificially generated shock front perturbations are observed to promote this type of instability. In all cases, instability is manifest by the appearance of vortex pairs during the expansive shock motion which follows the implosion.

81-1520
Shock Models with Phase Type Survival and Shock Resistance
M.F. Neuts and M.C. Bhattacharjee
Appl. Mathematics Inst., Delaware Univ., Newark,

DE, Rept. No. TR-61B, AFOSR-TR-80-0990, 14 pp (Aug 1980)
AD-A091 038/0

Key Words: Shock response, Mathematical models

New closure theorems for shock models in reliability theory are presented. If the number of shocks to failure and the times between the arrivals of shocks have probability distributions of phase type, then so has the time to failure. PH-distributions are highly versatile and may be used to model many qualitative features of practical interest. They are also well-suited for algorithmic implementation. The computational aspects of our results are discussed in some detail.

81-1521
Calculation of Ground Shock Motion Produced by Airburst Explosions Using Cagniard Elastic Propagation Theory

J.R. Britt
Structures Lab., Army Engineer Waterways Experiment Station, Vicksburg, MS, Rept. No. WES/MP/SL-80-12, 67 pp (Sept 1980)
AD-A090 031/6

Key Words: Aerial explosions, Ground shock, Computer programs

This report describes a study which used elastic wave propagation theory to predict ground motion produced by airburst explosions of spherical charges. The air-earth environment was treated as three elastic layers (air, soil, and rock) separated by plane parallel boundaries. The explosion was approximated by a point source in an elastic fluid. The exact, closed form integral solutions of L. Cagniard for the reflection and refraction of spherical waves in elastic solids were extended to model the ground shock propagation in layered earth. Nonlinear empirical airblast arrival time and pressure source waveform formulae were developed and were used as source inputs for the elastic calculations. A computer code CAGGS was developed to evaluate the integral solutions to produce ground shock particle velocity waveforms. Calculations were compared with experimental records, for soil-soil, soil-rock, and rock sites.

VIBRATION EXCITATION
(Also see Nos. 1551, 1559, 1560)

81-1522
Development of a Unified Numerical Procedure for Free Vibration Analysis of Structures

K.K. Gupta
Jet Propulsion Lab., Pasadena, CA, Rept. No. AFOSR-TR-80 0953, 7 pp (Aug 1980)
AD-A089 946/8

Key Words: Free vibration, Eigenvalue problems, Computer programs

The article presents the details of new numerical techniques developed. A numerical algorithm and a computer program have been successfully developed for the efficient and economical solution of structural eigenvalue problems. Both spinning and nonspinning structures with and without viscous and/or structural damping may be analyzed by the routine.

MECHANICAL PROPERTIES

DAMPING
(Also see No. 1404)

81-1523
Nonlinear Analysis of Squeeze Film Dampers Applied to Gas Turbine Helicopter Engines

E.J. Gunter, L.E. Barrett, and P.E. Allaire
Dept. of Mech. and Aerospace Engrg., Virginia Univ., Charlottesville, VA, Rept. No. ARO-14100.1-E, 13 pp (Nov 1980)
AD-A091 905/0

Key Words: Gas turbine engines, Squeeze film dampers, Helicopter engines

Application of the finite length correction factor for the analysis of the finite length squeeze film bearings has been made, and a method has been found to be highly efficient. The modal transient program, to include linear rotor acceleration, has been developed and various analyses of rotor systems have been done. A rapid method to calculate the load capacity and dynamics characteristics of a journal or squeeze film bearing has been developed using a finite element approach coupled with an end leakage correction factor. A procedure has been developed to balance a multistage turbine without having to first apply trial weights to generate a set of influence coefficients. This procedure represents a major advance in the technology of flexible rotor balancing. It is incorporated into a mini computer system which can collect and analyze the rotor data.

FATIGUE

(Also see Nos. 1438, 1530, 1544, 1546, 1564, 1566)

81-1524

A Methodology for the Evaluation of Fatigue Damage in Structures Exposed to Random Excitation

R.A. Kenny and S. Chandra

Nuclear Power Dept., Combustion Engrg., Windsor, CT 06095, J. Mech. Des., Trans. ASME, 102 (4), pp 732-733 (Oct 1980) 2 figs, 1 table 6 refs

Key Words: Fatigue life, Random excitation, Multidegree of freedom systems

A method for the determination of how many and which modes contribute significantly to the total response of multidegree of freedom systems to a wide band excitation and how the fatigue damage may be calculated for that response is presented.

81-1525

Static and Fatigue Testing of Precision Cast Steel and Aluminum

N. Larsson

Structures Dept., Aeronautical Res. Inst. of Sweden, Stockholm, Sweden, Rept. No. FFA-TN-HU-2106, 52 pp (July 1980)
N81-12223

Key Words: Fatigue tests, Steel, Aluminum

The specimen geometry and the testing procedure are detailed. The static tests show that for steel material the mean rupture stresses from different castings are very much the same, whereas the yield stresses vary considerably. The results from aluminum fatigue tests do not reveal any relation between life and thickness of specimen or casting.

ELASTICITY AND PLASTICITY

81-1526

Divergence and Flutter Instability of Elastically Restrained Structures under Follower Forces

A.N. Kounadis

National Tech. Univ. of Athens, Athens, Greece, Intl. J. Engrg. Sci., 19 (4), pp 553-562 (1981) 3 figs, 10 refs

Key Words: Flutter, Follower forces, Elastic media

The instability of elastically restrained simple structures acted upon by compressive follower forces is discussed by using a static stability analysis. From this investigation it is concluded that depending on the amount of elastic restraint: divergence or flutter type instability is possible and the critical load of a divergence type non-conservatively loaded structure may be higher or smaller than the critical load of the corresponding structure subjected to a conservative load. Moreover, a lower bound theorem is presented according to which under a certain condition the load carrying capacity of a non-conservatively loaded structure of divergence type is higher than the load carrying capacity of the corresponding conservatively loaded structure. From the foregoing findings a better insight into the actual mechanism of loss of stability of structures under follower forces is gained.

81-1527

Transient Response of a Single-Edge Crack in an Elastic Half-Plane

E.P. Chen

Sandia National Labs., Albuquerque, NM, Rept. No. CONF-8000846-1, 15 pp (1980)
SAND-80-1877C

Key Words: Elastic properties, Half-plane, Cracked media, Elastodynamic response, Transient response

The elasto-dynamic response of a single-edge crack in a semi-infinite elastic medium is considered in this study. The crack is assumed to appear suddenly in an elastic half-plane that is being stretched by a remote stress field. Near the crack, the interactions between the wave emanating from the tip and those reflected from the free edge take place. This investigation focuses its attention on the determination of the effect of this interaction on the stress intensity factor. Laplace and Fourier transforms are used to reduce the solution to a pair of dual integral equations. A numerical Laplace inversion procedure is used to obtain the time dependence of the solution. Numerical results on the dynamic stress intensity factor are obtained and are presented in a graphical form.

EXPERIMENTATION

MEASUREMENT AND ANALYSIS

(Also see Nos. 1420, 1571, 1574)

81-1528

Instrument for Measuring Dynamic Viscoelastic Properties

W.M. Madigosky and G.F. Lee

Dept. of the Navy, Washington, D.C., PAT-APPL-6-172 585, 17 pp (July 28, 1980)

Key Words: Measuring instruments, Viscoelastic properties, Elastomers

A method and apparatus for measuring the dynamic material constants of rubber compounds is disclosed. The rubber compound is tested in strip form by attaching one end of the strip to an electro-mechanical shaker while the opposite end of the strip is suspended under constant tension. The electromechanical shaker propagates an acoustic wave in the test strip and a piezoelectric transducer positioned at a first point on the test strip measures the mechanical response of the strip for phase and amplitude. The test values obtained are used to calculate Young's Modulus and the loss factor for the rubber compound.

81-1529

Resonator Configurations for Severe Environments

T.J. Lukaszek and A. Ballato

Dept. of the Army, Washington, D.C., PAT-APPL-6-145 180, 21 pp (Apr 30, 1980)

Key Words: Resonators, Measuring instruments

An arrangement is disclosed for piezoelectric resonators utilizing linear and parallel sides or flats located on the periphery and opposite ends of the resonator.

81-1530

Fatigue Cycle Sensor

M.J. Goes

Dept. of the Army, Washington, D.C., PAT-APPL-6-126 803, 11 pp (Mar 3, 1980)

Key Words: Fatigue (materials), Detectors

A fatigue cycle sensor that can integrate force with respect to time is presented.

81-1531

Noise Measurements and the dB

K.R. Maslen

Royal Aircraft Establishment Farnborough, UK, Rept. No. RAE-TM-FS-348; BR75369, 28 pp (July 1980)

N81-12827

Key Words: Noise measurement, Measurement techniques

The conventional use of the dB in studies of acoustic noise can be said to obscure and complicate simple relationships and lead to the possibility of error because of misunderstandings of the nature of logarithms and because the order of the numbers involved is concealed by the compressed scale. Examples of errors and inaccuracies are given and some cases where consideration of noise in terms of rms pressure would be simpler, or would lead to better understanding of the processes involved, are discussed. It is suggested that although the dB may be a convenient unit for many purposes, more emphasis on the physical nature of noise would help in the interpretation of phenomena and prevent some of the confusions that arise, especially in dealing with the general public.

81-1532

Investigation of Inherent Ship Hull Vibrations Using a Digital Signal Analyser

G. Witte

Gesellschaft fuer Kernenergieverwertung in Schiffbau und Schiffahrt m.b.H., Geesthacht-Tesperhude, F.R. Germany, 4 pp (Dec 1979)

GKSS-79/E/33

(In German)

Key Words: Ship hulls, Ship vibration, Vibration analyzers, Digital techniques, Flexural vibration, Torsional vibration, Propeller induced excitation, Water waves

Using an up-to-date digital analyzer the overall resonant hull vibrations of the NS 'Otto Hahn' were determined. This

device gives the possibility of recording the vertical and horizontal bending vibration as well as the torsional vibrations in a very quick and effective manner. In addition to the natural frequencies the vibrational modes, the excitation of vibrations due to the propeller and to slamming forces, and the influence of shallow water were also measured.

81-1533
System to Measure the Pressure Distribution on Fan Aerofoil Surfaces During Flutter Conditions

J.W.H. Chivers
Rolls-Royce Ltd., Derby, UK, Rept. No. PNR-90013, 6 pp (1980)
N81-12029

Key Words: Measurement techniques, Measuring instruments, Flutter, Fans, Fan blades

High speed flutter tests were conducted on a research fan in which the blade surface pressures were measured by means of miniature silicon diaphragm pressure transducers embedded in selected fan blades. The effects of centrifugal force and vibration on the transducer performance and a transducer mounting technique was developed to minimize blade induced stress in the transducer. Instantaneous measurements of the tip stagger angles of the pressure instrumented fan blades enabled a cross correlation to be made on the blade surface pressure data and the blade tip angles.

81-1534
Improved Performance of Receiving Arrays in the Presence of Localized Nearfield Noise Sources

A.L. Van Buren
Underwater Sound Reference Detachment, Naval Res. Lab., P.O. Box 8337, Orlando, FL 32856, J. Acoust. Soc. Amer., 69 (3), pp 681-688 (Mar 1981)
14 figs, 3 tables, 6 refs

Key Words: Arrays, Acoustic arrays, Shading techniques, Measurement techniques

This paper describes an element shading technique for improving the performance of a receiving array in the presence of localized nearfield noise sources. The shading reduces the array response over a prescribed frequency range to sound sources located within a prescribed nearfield volume while retaining desirable farfield characteristics. A numerical technique is presented for computing the optimum (in the least-squares sense) shading coefficients for a given array, frequency range, nearfield volume, and desired farfield characteristics.

81-1535
Nonperiodic Forced Overflow Oscillations in Digital Filters

H. Samueli
Ph.D. Thesis, Univ. of California, Los Angeles, 87 pp (1980)
UM 8102874

Key Words: Digital filters, Oscillation, Forced vibrations

Forced overflow oscillations are investigated in a second-order digital filter, whose input sequence is constructed by uniformly sampling a periodic waveform. It is shown that even when the frequency of the input waveform is constrained to an arbitrarily small interval of values, the digital filter is still susceptible to forced overflow oscillations. Furthermore, when the input sequence is obtained by incommensurably sampling a periodic waveform, it is demonstrated that nonperiodic forced overflow oscillations can be sustained in the digital filter. Necessary and sufficient conditions for the existence of nonperiodic forced overflow oscillations are given.

DYNAMIC TESTS
(Also see No. 1525)

81-1536
Test Methods for the Dynamic Mechanical Properties of Polymeric Materials

G.K. Baker
Bendix Corp., Kansas City, MO, Rept. No. BDX-613-2405, 70 pp (June 1980)
N81-12246

Key Words: Testing techniques, Dynamic tests, Polymers

Various test geometries and procedures for the dynamic mechanical analysis of polymers employing a mechanical spectrometer were evaluated. The methods and materials included were forced torsional pendulum testing of Kevlar/epoxy laminates and rigid urethane foams, oscillatory parallel plate testing to determine the kinetics of the cure of VCE with Hylene MP, oscillatory compressive testing of B-3223 cellular silicone, and oscillatory tensile testing of Silastic E and single Kevlar filaments. Fundaments dynamic mechanical

properties, including the storage and loss moduli and loss tangent of the materials tested, were determined as a function of temperature and sometimes of frequency.

81-1537
Bench Scale Dynamic Evaluation Apparatus for Integral Fuel Tank Sealants

W.R. Mallory, L.E. Isom, and W.F. Anspach
Systems Res. Labs., Inc., Dayton, OH, J. Aircraft, 17 (10), pp 748-752 (Oct 1980) 6 figs

Key Words: Test equipment and instrumentation, Seals, Fuel tanks, Aircraft

Dynamic testing which exposes the materials to conditions typical of those encountered in the aircraft during flight, essential to predict accurately the performance of the material in actual use, is discussed. A unique bench scale dynamic test apparatus can be programmed to simulate a great number of integral fuel tank environments. This device allows precise measurement and control of loads, temperatures, pressures, fuel exposure, and other parameters, yet is reliable and versatile. This capability for exposing sealant materials to typical loads during environmental testing allows accurate prediction of the performance of the material in actual use. This paper describes the dynamic test apparatus and its use to evaluate integral fuel tank sealants.

81-1538
Feed Pump Vibration Research - Interstage Fluid Annuli

M.L. Adams, Jr., E. Makay, and J.P. Dimmer
Univ. of Akron, Akron, OH, ASME Paper No. 80-JPGC/Pwr-20

Key Words: Test equipment and instrumentation, Pumps, Rotors, Vibration damping

An experimental test apparatus has been developed and designed to acquire the information necessary to evaluate various fluid annuli configurations which could potentially add considerable vibration damping to existing rotor/bearing systems. The overall approach and a description of the test apparatus are provided in this paper.

81-1539
The Design and Application of an Integrated System for Dynamic Testing of Nuclear Generating Stations

J.H. Bickel
Ph.D. Thesis, Rensselaer Polytechnic Inst., 301 pp (1980)
UM 8103750

Key Words: Nuclear power plants, Dynamic tests

The objective of this project was to develop a portable self-contained dynamic testing system for determining frequency response of nuclear steam supply system components and more important tuning and calibrating automatic control systems.

DIAGNOSTICS
(Also see Nos. 1501, 1574)

81-1540
An Appraisal of Schroeder-Phased Harmonic Signals for Bearing Identification

C.R. Burrow
Univ. of Sussex, UK, ASME Paper No. 80-WA/DSC-34

Key Words: Rotors, Bearings, Signal processing techniques

The criteria to be satisfied by a test procedure to identify rotor/bearing systems are discussed. It is shown to be advantageous to take account of the inherent multivariable nature of the problem and this implies the need for a signal capable of persistently exciting all of the modes.

81-1541
Operational Parameters in Acoustic Signature Inspection of Railroad Wheels

C. Dousis and R.D. Finch
Dept. of Mech. Engrg., Houston Univ., TX, Rept. No. DOT-TSC-FRA-80-9, FRA/ORD-80/21, 296 pp (Apr 1980)
PB81-116766

Key Words: Diagnostic techniques, Railway wheels, Acoustic signatures

A brief summary is given of some prior studies which established the feasibility of using acoustic signatures for inspection of railroad wheels. The purpose of the present work was to elucidate operational parameters which would be of importance for the development of a prototype system. Experimental and theoretical investigations were conducted to obtain more information on the effects on wheel vibrations of geometrical variations, wear, and internal stress.

81-1542

Surface Intensity Measurements on a Diesel Engine

M.C. McGary and M.J. Crocker

NASA Langley Res. Ctr., Hampton, VA 23665, Noise Control Engrg., 16 (1), pp 27-36 (Jan/Feb 1981) 20 figs, 18 refs

Key Words: Diesel engines, Engines, Noise source identification, Surface intensity technique, Diagnostic techniques

The surface intensity (microphone-accelerometer) approach to identify noise sources on the surface of a diesel engine is discussed. Noise information obtained using the new surface intensity approach is compared to the older, lead-wrapping approach. It is shown that the surface intensity approach can be used to determine the sound power radiated from different surfaces of such a machine more accurately and rapidly than the lead-wrapping technique.

BALANCING

81-1543

The Balancing of Rotating Shafts by Quadratic Programming

E. Woomer and W. Pilkey

Univ. of Virginia, Charlottesville, VA, ASME Paper No. 80-DET-45

Key Words: Balancing techniques, Nonlinear programming, Shafts (machine elements)

The application of quadratic programming methods to the computation of balance weights for rotating shafts is demonstrated. The use of the quadratic programming technique makes possible the minimization of the sum of the squares of the deflections of the balanced shaft when upper bounds have been placed on the magnitudes of the components of the correction weights.

MONITORING

81-1544

Studies on the Monitoring of Fatigue Crack Propagation by Acoustic Emission Method in Alternated Internal Pressure Tests of Model LWR Pressure Vessel and NSRR Inconel 718 Tube

Japan Atomic Energy Res. Inst., Tokyo, Japan, 50 pp (Jan 1979)
JAERI-M-8005
(In Japanese)

Key Words: Nuclear reactor components, Pressure vessels, Piping systems, Fatigue life, Monitoring techniques, Acoustic emission

An acoustic emission method is recently applied to defects monitoring in the nuclear pressure vessel and piping for their nondestructive inspection. Some problems remain, however, for its practicability in the monitoring of nuclear power plants. The acoustic emission procedure for monitoring the fatigue crack propagation has been studied in cyclic internal pressure tests of model LWR pressure vessel and NSRR Inconel 718 tube as a co-operative research work between the Japan Atomic Energy Research Institute and the Central Research Institute of Electric Power Industry. The results obtained by this study are described.

81-1545

Acoustic Monitoring Systems Tests at Indian Point Unit 1. Final Report

J.R. Smith, G.V. Rao, and J. Craig

Nuclear Energy Systems Div., Westinghouse Electric Corp., Pittsburgh, PA, COO-2974-2, 104 pp (Dec 1979)

Key Words: Monitoring techniques, Acoustic emission, Nuclear power plants

This report describes the results of a program to test acoustic monitoring systems on Indian Point Unit No. 1 under actual plant operating conditions, less the reactor core. The two types of systems evaluated were the monitoring of acoustic emissions generated by growing flaws and the monitoring of acoustic signals from leaks.

81-1546

A Multiprocessor System for Creep Fatigue Test Monitoring

M. Monici and A. Stefanini

Documentation Service, Centro Informazioni Studi Esperienze, Milan, Italy, Rept. No. CISE-1531, 12 pp (Nov 1979)
N81-12462

Key Words: Monitoring techniques, Fatigue tests, Computer aided techniques

A data acquisition and operation monitoring system of the equipment for creep fatigue and environmental fatigue tests was designed. The system is based on a multiprocessor hierarchical structure, built up by single processor functional units mutually linked via serial channels. It was designed for fault detection and is to work under conditions of partial degradation.

81-1547

Synopsis on Aircraft Integrated Data Systems and Engine Health Monitoring and Maintenance

G. Dahl, H. Hardegen, and W. Hentschel

Inst. fuer Flugfuehrung, Deutsch Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick, W. Germany, Rept. No. DFVLR-Mitt-80-08, 240 pp (1980)

N81-12063

Key Words: Aircraft engines, Monitoring techniques

Summaries and a comparative survey in tabular form are given of the main points of 304 references on aircraft integrated data systems, engine monitoring, fault detection, and maintenance. Instruments, recording systems, analysis methods, and results are classified by characteristics.

ANALYSIS AND DESIGN

ANALYTICAL METHODS

81-1548

An Adaptive Control Scheme for Mechanical Manipulators – Compensation of Nonlinearity and Decoupling Control

R. Horowitz and M. Tomizuka

Univ. of California, Berkeley, CA, ASME Paper No. 80-WA/DSC-6

Key Words: Manipulators, Remote control

This paper presents a new adaptive control scheme for mechanical manipulators. Making use of the fundamental properties of the manipulator equations, a simple adaptive algorithm is developed for compensating a nonlinear term in the dynamic equations and for decoupling the dynamic interaction.

81-1549

A Comparison of Natural Frequency Prediction Methods for Flexible Manipulator Arms

W.J. Book and M. Majette

Georgia Inst of Tech., Atlanta, GA, ASME Paper No. 80-WA/DSC-19

Key Words: Manipulators, Remote control, Natural frequencies, Space shuttles

Predictions of natural frequencies of flexible manipulator arms as performed by alternative structural models and computer implementations are compared. The space shuttle remote manipulator system manipulator arm is used as the basis for comparison. Finite element and transfer matrix implementations of Bernoulli Euler, lumped mass, and consistent mass models are considered.

81-1550

Some Asymptotic Results for a Class of Stochastic Systems with Parametric Excitations

P.R. Sethna and S. Orey

Dept. of Aerospace Engrg. and Mechanics, Univ. of Minnesota, Intl. J. Nonlin. Mechanics, 15 (6), pp 431-441 (1980) 13 refs

Key Words: Parametric excitation, Stochastic processes

Systems of stochastic ordinary differential equations dependent on a small parameter are studied. The equations are assumed to depend on two time scales: they are stochastic in a fast time and they are deterministic in a slow time. The method of analysis is based on a generalization of the Method of Averaging. The mathematical results given are applied to several examples of parametrically excited dynamical systems.

81-1551

Phase Portraits and Bifurcations of the Non-Linear Oscillator: $\ddot{\chi} + (\alpha + \gamma\chi^2)\dot{\chi} + \beta\chi + \delta\chi^3 = 0$

P. Holmes and D. Rand

Dept. of Theoretical and Appl. Mechanics, Cornell Univ., Ithaca, NY 14853, Intl. J. Nonlin. Mechanics, 15 (6), pp 449-458 (1980) 6 figs, 20 refs

Key Words: Oscillators, Nonlinear systems, Fluid-induced excitation

A non-linear oscillator is studied using the methods of differentiable dynamics to obtain qualitative behavior. Special cases are considered in some detail. The oscillator has physical relevance as a simple model in certain flow-induced structural vibration problems in which the structural non-linearities act to maintain overall stability. The presence of local and global bifurcations is detected and their physical significance discussed.

81-1552

The Method of Successive Integration of the Linear Inhomogeneous Wave Equations in the Theory of Transient Wave Propagation in Non-Linear Hereditary Elastic Media

U. Nigul
Inst. of Cybernetics, Lenin Ave 10, 200104 Tallinn, Estonian S.S.R., Intl. J. Nonlin. Mechanics, 15 (6), pp 469-483 (1980) 7 refs

Key Words: Integral equations, Wave equation, Wave propagation, Elastic media

A moderate distortion of the initial pulse form which takes place when a one-dimensional longitudinal pulse propagates through a sufficiently small distance in a non-linear hereditary elastic medium is considered. Its first- and second-order asymptotic solutions are derived with the aid of a method of successive integration of the linear inhomogeneous wave equations. Besides the constants which define the wave speed and the non-linear properties of the medium, the asymptotic solutions suggested in this paper contain two arbitrary functions whose properties are restricted only by certain smoothness conditions. An example of the use of the asymptotic solutions is presented in which these two functions are given explicitly.

81-1553

On the Stability of Generalized Hill's Equation with Three Independent Parameters

M.M. Stanisic
School of Aeronautics and Astronautics, Purdue Univ., West Lafayette, IN 47907, Intl. J. Nonlin. Mechanics, 15 (6), pp 485-496 (1980) 5 figs, 9 refs

Key Words: Stability, Hill equation

This paper presents a stability criterion of a generalized Hill's equation with three independent parameters, examined by means of an asymptotic method. The theory has been applied to a special form of Hill's equation and the region of stability has been graphically illustrated. The separatrix between bounded and unbounded solutions yields in parametric space the contour of a 'stabilitatskorper' in which the solution is always stable.

81-1554

On the Dynamic Simulation of Large Nonlinear Mechanical Systems: Part I - An Overview of the Simulation Technique. Substructuring and Frequency Domain Consideration

R.J. Cipra and J.J. Uicker, Jr.
Purdue Univ., West Lafayette, IN, ASME Paper No. 80-DET-66

Key Words: Simulation, Substructuring methods, Frequency domain method

An analytical technique is presented for determining the dynamic response of large complex nonlinear systems. The simulation technique is aimed at this class of problems having many describing coordinates, a complex model description, and nonlinear effects which need to be included for sufficient accuracy.

81-1555

On the Dynamic Simulation of Large Nonlinear Mechanical Systems: Part II - The Time Integration Technique and Time Response Loop

R.J. Cipra and J.J. Uicker, Jr.
Purdue Univ., West Lafayette, IN, ASME Paper No. 80-DET-67

Key Words: Simulation, Mechanical systems, Integration

A time integration technique for nonlinear differential equations is presented. Its use in the time response loop of the simulation technique is illustrated. The time integration method for nonlinear differential equations is based upon the repetitive analytical (modal) solution of a set of equations linearized about the current operating position.

81-1556

Synthesis of Two-Degree-of-Freedom Mechanism with Pulse Loading

C.K.C. Jaini and A.C. Rao

Government Engrg. College, Jabalpur, India, ASME Paper No. 80-DET-82

Key Words: Mechanisms, Structural synthesis, Two degree of freedom systems, Pulse excitation, Damping effects

In this paper, a two-degree-of-freedom mechanism consisting of flexible elements, proposed by Rao, subjected to pulse loading is investigated for position synthesis. Damping is considered in this case and the displacement equation is presented in a form suitable for easy synthesis.

81-1557
Dynamic Analysis of Variators with Half Ball and Two Discs as Non-Holonomic Systems

M.Z. Zlokolica and R.V. Popov
Univ. of Novi Sad, Yugoslavia, ASME Paper No. 80-DET-95

Key Words: Nonholonomic systems

In this paper a method is given for the dynamic analysis of a mechanical system with non-holonomic connections. Appell's equations for non-holonomic systems are used for the analysis of a variator with two discs and half ball with point contact. As a result of the dynamic analysis the change of ratio and angular speed in the system are found.

81-1558
Dynamic Analysis of Machines Using Programmable Desk Computers (Dynamische Maschinenanalyse mit Hilfe programierbarer Tischrechner)

H. Kerle
Institut f. Getriebelehre u. Maschinendynamik der T.U. Braunschweig, Germany, Forsch. Ingenieurwesen, 46 (5), pp 149-153 (1980) 8 figs, 15 refs (In German)

Key Words: Dynamic analysis, Computer-aided techniques

A nonlinear differential equation of 2nd order with periodic coefficients describes the behavior of a rigid machine under the influence of autonomous forces. The machine has only one degree of freedom, i.e., the angle of rotation of the driving member. The differential equation reduces to an initial-value problem to be solved with the "polygon method" on a programmable desk computer. The conditions of periodicity prove to be a useful tool when the quality of numerical results is to be checked.

MODELING TECHNIQUES
(See No. 1569)

NUMERICAL METHODS

81-1559
Development of a Unified Numerical Procedure for Free Vibration Analysis of Structures

K.K. Gupta
Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA, Intl. J. Numer. Methods Engrg., 17 (2), pp 187-198 (Feb 1981) 3 figs, 1 table, 5 refs

Key Words: Numerical analysis, Computer programs, Natural frequencies, Mode shapes

This paper presents the details of a unified numerical algorithm and the associated computer program developed for the efficient determination of natural frequencies and modes of free vibration of structures. Both spinning and nonspinning structures with or without viscous and/or structural damping may be solved by the current procedure; in addition, the program is capable of solving static problems with multiple load cases as well as the quadratic matrix eigenproblem associated with a finite dynamic element structural discretization. A special symmetric matrix decomposition scheme has been adopted for matrix triangularization, which renders the program rather efficient and economical.

81-1560
Numerical Integration of Structural Dynamics Equations Including Natural Damping and Periodic Forcing Terms

W.L. Wood
Dept. of Mathematics, Univ. of Reading, UK, Intl. J. Numer. Methods Engrg., 17 (2), pp 281-289 (Feb 1981) 15 refs

Key Words: Numerical analysis, Integral equations, Damping effects, Periodic excitation

This paper shows that it is comparatively simple to analyze algorithms for the numerical integration of the space discretized equations from structural dynamics. The method is illustrated on some three- and four-time-level schemes.

81-1561

Comparative Study of Direct Numerical Integration Schemes in Linear and Nonlinear Analysis of a Dynamic System

V.K. Garg and T.J. Thomas

Assoc. of American Railroads, Chicago, IL, ASME Paper No. 80-WA/DSC-26

Key Words: Dynamic systems, Numerical analysis, Iteration, Nonlinear systems, Linear systems

Performances of the explicit and implicit integration schemes in the linear and nonlinear analyses of a dynamic system are evaluated with respect to the computational time, stability and accuracy of solution. Three widely used explicit schemes, namely the central difference predictor, two cycle iteration with trapizoidal rule and fourth-order Runge-Kutta are considered.

81-1562

Iterative Methods for Solving the Exterior Dirichlet Problem for the Helmholtz Equation with Applications to the Inverse Scattering Problem for Low Frequency Acoustic Waves

D. Colton and R. Kress

Appl. Mathematics Inst., Delaware Univ., Newark, DE, Rept. No. TR-72A, AFOSR-TR-80-0637, 21 pp (May 15, 1980)

AD-A089 873/4

Key Words: Iteration, Acoustic waves, Wave scattering, Conformal mapping

A previous paper presented an iterative method for solving the exterior Dirichlet problem for the Helmholtz equation defined in the plane and used this result to provide a constructive approach for solving the low frequency inverse scattering problem for a cylinder. These results were based on the use of conformal mapping and the fact that the integral of the normal derivative of the total field over the boundary of the obstacle vanishes, neither of which is valid in the three dimensional case. The present paper shows how the previous analysis can be modified in order to extend these results to the case of the exterior Dirichlet problem for the Helmholtz equation. These results are based on choosing an appropriate fundamental solution such that the integral equation associated with the exterior Dirichlet problem can be solved by iteration for sufficiently small values of the wave number.

PARAMETER IDENTIFICATION

81-1563

Reflection Coefficient Identification by Means of Correlation: Application to a Layered Medium

C. Gazanhes, J.P. Herault, and K. Stephanakis

Laboratoire d'Acoustique, Centre National de la Recherche Scientifique, 31 Chemin Joseph-Aiguier, BP71 13977 Marseille Cedex 9, France, J. Acoust. Soc. Amer., 69 (3), pp 720-727 (Mar 1981) 9 figs, 2 tables, 9 refs

Key Words: Layered materials, Wave reflection, Signal processing techniques, Parameter identification technique

Signal processing techniques are applied to determine the reflection coefficients of a layered medium. A frequency modulated signal propagating through the medium is reflected back by the different layers giving rise to several echoes. The cross-correlation function between the echoes and the transmitted signal exhibits peaks at lag corresponding to the time delays associated with the various layers; the amplitude of the peaks are related to the reflection coefficients. In order to compute these reflection coefficients automatically on a digital computer, a theoretical model was derived from the wave equation.

DESIGN TECHNIQUES

81-1564

Combined Fatigue Stress Concentration Factor Determination

G.M. Kurajian and T.Y. Na

The Univ. of Michigan, Dearborn, MI 48128, J. Mech. Des., Trans. ASME, 102 (4), pp 727-731 (Oct 1980) 4 figs, 4 tables, 11 refs

Key Words: Design techniques, Machinery components, Shafts, Fatigue life

The paper begins with an overview of the spectrum of methods employed by different designers to account for all stress concentration effects in calculations for use in the design of machine elements and components subjected to combined fatigue loadings. Then, on the basis of the widely accepted von Mises-Goodman approach, and the method deemed the best for incorporating combined stress concentration effects, a general expression is derived for the combined fatigue stress concentration factor which is applicable to any machine element or component subjected to any combination

of fatigue loadings. Various load combinations are considered not only to illustrate the use of the derived expression, but also to demonstrate other methods which may lead to calculations which are incorrect depending upon the nature and magnitude of the parameters involved. The specific machine component, that of a stepped shaft subjected to combined fatigue loadings, is selected for particular, detailed and further demonstration. Demonstrative tables and a curve plot are also included.

81-1565
Design of Vibratory Systems with Aid of Dimensional Analysis

M.S. Hundal
Dept. of Mech. Engrg., Univ. of Vermont, Burlington, VT 05405, J. Mech. Des., Trans. ASME, 102 (4), pp 835-841 (Oct 1980) 7 figs, 4 tables, 5 refs

Key Words: Design techniques, Dimensional analysis, Vibrating structures, Flexible rotors, Rotors, Computer programs

The paper presents the use of dimensional analysis as an aid in the design of dynamic systems. Basic theory of dimensional analysis is discussed. Two examples are given: a two degree of freedom vibrating system and a flexible rotor which is flexibly supported at its ends. Choice of suitable non-dimensional parameters is discussed. A digital computer program is described which generates all of the possible sets of non-dimensional parameters for a given problem.

COMPUTER PROGRAMS

(Also see Nos. 1522, 1559)

81-1566
A Computer Program for Cyclic Plasticity and Structural Fatigue Analysis

I. Kalev
Hugh L. Dryden Flight Res. Ctr., NASA, Edwards, CA, Rept. No. NASA-CR-163101, H-1139, 43 pp (Nov 1980)
N81-11031

Key Words: Computer programs, Fatigue life, Crack propagation

A computerized tool for the analysis of time independent cyclic plasticity structural response, life to crack initiation prediction, and crack growth rate prediction for metallic materials is described. Three analytical items are combined: the finite element method with its associated numerical techniques for idealization of the structural component, cyclic plasticity models for idealization of the material behavior, and damage accumulation criteria for the fatigue failure.

81-1567
A Computer Program to Calculate the Longitudinal Aerodynamic Characteristics of Upper-Surface-Blown Wing-Flap Configurations

M.R. Mendenhall
Nielsen Engrg. & Res., Inc., Mountain View, CA, Rept. No. NASA-CR-3005; NEAR-TR-158, 103 pp (Aug 1978)
N81-12014

Key Words: Computer programs, Aircraft wings, Aerodynamic stability

A user's manual is presented for a computer program in which a vortex-lattice lifting-surface method is used to model the wing and multiple flaps. The engine wake model consists of a series of closely spaced vortex rings with rectangular cross sections. The jet wake is positioned such that the lower boundary of the jet is tangent to the wing and flap upper surfaces. The two potential flow models are used to calculate the wing-flap loading distribution including the influence of the wakes from up to two engines on the semispan. The method is limited to the condition where the flow and geometry of the configurations are symmetric about the vertical plane containing the wing root chord. The use of the program, preparation of input, the output, program listing, and sample cases are described.

GENERAL TOPICS

CONFERENCE PROCEEDINGS

81-1568
An Advanced Course in Noise and Vibration

Inst. Sound Vib. Res., Univ. of Southampton, UK, September, 1980

Key Words: Proceedings, Spacecraft, Aircraft, Noise generation, Monitoring techniques, Ground vehicles

The course was originally designed for research workers associated with aerospace industry. Now the course also includes a discussion of mechanical noise sources, machinery health monitoring, and road vehicle noise, as well as subjective effects of noise and vibration. About half the chapters are directed towards understanding the basic principles of acoustics, vibration and relative topics. The remaining chapters are concerned with the application of this knowledge to specific problems.

TUTORIALS AND REVIEWS

81-1569
Underwater Acoustic Modeling Techniques

P.C. Etter
MAR Inc., 1335 Rockville Pike, Rockville, MD 20852, Shock Vib. Dig., 13 (2), pp 11-20 (Feb 1981) 3 tables, 93 refs

Key Words: Reviews, Underwater sound, Mathematical models

This paper presents a state-of-the-art literature review of underwater acoustic models developed by the Navy sonar modeling community. Three types of acoustic models are addressed: propagation loss, noise, and active sonar/reverberation models. Basic features of each type of model and areas of application are discussed. Problems associated with model evaluation and validation are described.

81-1570
Vibration Analysis of Highway Bridges

H.V.S. GangaRao and C.A. Haslebacher
Civil Engrg. Dept., West Virginia Univ., Morgantown, WV 26506, Shock Vib. Dig., 13 (2), pp 3-8 (Feb 1981) 32 refs

Key Words: Reviews, Bridges, Vibration response, Vibration excitation, Human response

This article is divided into two main sections: one deals with the vibrations and deflections of highway bridges; the other deals with human tolerance to bridge vibrations. Experimental work and theoretical analyses of vibrations and deflections are reviewed in the first section. The second section describes the literature on human tolerance levels for highway bridge vibrations and suggests certain limits as functions of bridge and vehicle parameters to prevent amplitude levels that could lead to intolerability.

81-1571
Impedance Methods for Machine Analysis

M. Massoud
Faculty of Appl. Sciences, Univ. of Sherbrooke, Sherbrooke, Quebec, Canada, Shock Vib. Dig., 13 (3), pp 17-21 (Mar 1981) 43 refs

Key Words: Reviews, Impedance technique

This paper is a follow-up of an earlier review in which basic definitions, mathematical background, and test procedures of the impedance of mechanical systems were given. The present review is restricted to literature published from 1977 to the present. The impedance of acoustical phenomena associated with mechanical systems is emphasized.

81-1572
Aircraft Crash Dynamics: Some Major Considerations

G. Wittlin
Lockheed-California Co., Burbank, CA 91520, Shock Vib. Dig., 13 (3), pp 3-15 (Mar 1981) 6 figs, 5 tables, 41 refs

Key Words: Reviews, Crash research (aircraft)

This article describes three major considerations in aircraft crash dynamics. The considerations are aircraft crash environments, available analytical methods, and occupant protection. The aircraft crash environment varies depending on aircraft size, configuration, and usage. Current crash design requirements for military and civil helicopters, small airplanes, and large airplanes are presented. Analytical modeling of crash behavior requires three levels of capability: simple, intermediate, and detailed. Brief descriptions of methods and reference simulations are provided. Occupant protection, which is the goal of the crash design effort, is related to a design in which the load capability of the various systems -- i.e., landing gear, airframe, seats, and occupants -- is compatible with the crash environment. Occupant protection is dependent on many crash-related factors.

81-1573
Review of Literatue and Regulation Relating to Head Impact Tolerance and Injury Criteria

R.L. Hess, K. Weber, and J.W. Melvin

Highway Safety Res. Inst., Michigan Univ., Ann Arbor, MI, Rept. No. UM-HSRI-80-52-1, 100 pp (July 1980)
PB81-123101

Key Words: Reviews, Human response, Head (anatomy)

Regulation that relates to head injury protection of motor vehicle occupants is examined in relation to head injury biomechanics research. The development of both is presented in a historical review. Recommendations are made for more effective use of the experimental and analytical techniques already available and for further research in these areas.

CRITERIA, STANDARDS, AND SPECIFICATIONS

81-1574
Standards for Noise Measurements
W.W. Lang

IBM Acoustics Lab., C18/704, P.O. Box 390, Poughkeepsie, NY 12602, Noise Control Engrg., 16 (1), pp 37-45 (Jan/Feb 1981) 2 figs, 4 tables, 10 refs

Key Words: Noise measurement, Standards and codes, Testing techniques, Diagnostic techniques

The newcomer to the field of noise control is faced with a bewildering array of standards relating to noise measurements. It is shown how standards are used to guide the making of measurements on different types of noise sources. Acceptability testing of machinery and equipment and diagnostic analysis on which to base engineering noise control are discussed. Methods for using sound pressure level data and for computing the sound power levels of sources are described. Finally, a synopsis is given of recently published American National Standard S1.36, which is the simplest possible procedure to be followed in order to obtain the A-weighted sound power level of a stationary noise source. This article shows how national and international standards are important to any noise measurement or noise control program.

AUTHOR INDEX

CALENDAR

AUGUST 1981

3-6 West Coast International Meeting [SAE] Seattle, WA *(SAE Hqs.)*

SEPTEMBER 1981

1-4 Joint Meeting of the British Society for Strain Measurement and the Society for Experimental Stress Analysis [B.S.S.M. and SESA] Edinburgh University, Scotland *(C. McCalvey, Administration Officer, B.S.S.M., 281 Heaton Road, Newcastle upon Tyne, NE6 5QB, UK)*

7-11 Applied Modelling and Simulation Conference and Exhibition [I.A.S.T.E.D. and A.M.S.E.] Lyon, France *(A.M.S.E., 15, Avenue de Grande Blanche, 69160 Tassin-La-Demi-Lune, France)*

14-17 International Off-Highway Meeting and Exposition [SAE] Milwaukee, WI *(SAE Hqs.)*

20-23 Design Engineering Technical Confernce [ASME] Hartford, CT *(ASME Hqs.)*

28-30 Specialists Meeting on "Dynamic Environmental Qualification Techniques" [AGARD Structures and Materials Panel] Noordwijkerhout, The Netherlands *(Dr. James J. Olsen, Structures and Dynamics Division, Air Force Wright Aeronautical Laboratories/FIB, Wright Patterson Air Force Base, OH 45433)*

28-30 Stapp Car Crash Conference [SAE] San Francisco, CA *(SAE Hqs.)*

30-Oct 2 International Congress on Recent Developments in Acoustic Intensity Measurement [CETIM] Senlis, France *(Dr. M. Bockhoff, Centre Technique des Industries Mecaniques, Boite Postale 67, F-60304, Senlis, France)*

OCTOBER 1981

4-7 International Lubrication Conference [ASME - ASLE] New Orleans, LA *(ASME Hqs.)*

5-8 SAE Aerospace Congress and Exposition [SAE] Anaheim, CA *(Roy W. Mustain, Rockwell Space Systems Group, AB 97, 12214 S. Lakewood Blvd., Downey, CA 90241)*

11-15 Fall Meeting of the Society for Experimental Stress Analysis [SESA] Keystone Resort, Keystone, CO *(SESA, P.O. Box 277, Saugatuck Station, Westport, CT 06880)*

19-22 Intl. Optimum Structural Design Symp. [U.S. Office of Naval Research and Univ. of Arizona] Tucson, AZ *(Dr. Erdal Atrek, Dept. of Civil Engr., Bldg. No. 72, Univ. of Arizona, Tucson, AZ 85721)*

21-23 34th Mechanical Failures Prevention Group Symp. [National Bureau of Standards] Gaithersburg, MD *(J.E. Stern, Trident Engineering Associates, 1507 Amherst Rd., Hyattsville, MD 20783 - (301) 422-9506)*

26-30 ASCE Annual Convention & Exposition [ASCE] St. Louis, MO *(ASCE Hqs.)*

27-29 52nd Shock and Vibration Symposium [Shock and Vibration Information Center, Washington, D.C.] New Orleans, Louisiana *(Henry C. Pusey, Director, SVIC, Naval Research Lab., Code 5804, Washington, D.C. 20375)*

NOVEMBER 1981

9-12 Truck Meeting & Exposition [SAE] Dearborn, MI *(SAE Hqs.)*

15-20 ASME Winter Annual Meeting [ASME] Washington, D.C. *(ASME Hqs.)*

16-19 International Pacific Conference on Automotive Engineering [SAE] Honolulu, Hawaii *(SAE Hqs.)*

17-19 Technical Diagnostics Symposium [IMEKO Technical Committee on Technical Diagnostics] London, England *(Institute of Measurement and Control, 20 Peel Street, London W8 7PD, England)*

18-20 Fourth SAE International Conference on Vehicle Structural Mechanics [SAE] Detroit, MI *(SAE Hqs.)*

30-Dec 4 Acoustical Society of America, Fall Meeting [ASA] Miami Beach, FL *(ASA Hqs.)*

DECEMBER 1981

1-3 10th Turbomachinery Symposium [Texas A&M Univ.] Houston, TX *(Peter E. Jenkins, Director, Turbomachinery Laboratories, Dept. of Mechanical Engineering, Texas A&M Univ., College Station, TX 77843 - (713) 845-7417)*

1-3 Automotive Plastics Durability Conference & Exposition [SAE] Troy, MI *(SAE Hqs.)*

8-10 Western Design Engineering Show [ASME] Anaheim, CA *(ASME Hqs.)*

CALENDAR ACRONYM DEFINITIONS AND ADDRESSES OF SOCIETY HEADQUARTERS

AFIPS: American Federation of Information Processing Societies
210 Summit Ave., Montvale, NJ 07645

AGMA: American Gear Manufacturers Association
1330 Mass Ave., N.W.
Washington, D.C.

AHS: American Helicopter Society
1325 18 St. N.W.
Washington, D.C. 20036

AIAA: American Institute of Aeronautics and Astronautics, 1290 Sixth Ave.
New York, NY 10019

AIChE: American Institute of Chemical Engineers
345 E. 47th St.
New York, NY 10017

AREA: American Railway Engineering Association
59 E. Van Buren St.
Chicago, IL 60605

ARPA: Advanced Research Projects Agency

ASA: Acoustical Society of America
335 E. 45th St.
New York, NY 10017

ASCE: American Society of Civil Engineers
345 E. 45th St.
New York, NY 10017

ASME: American Society of Mechanical Engineers
345 E. 45th St.
New York, NY 10017

ASNT: American Society for Nondestructive Testing
914 Chicago Ave.
Evanston, IL 60202

ASQC: American Society for Quality Control
161 W. Wisconsin Ave.
Milwaukee, WI 53203

ASTM: American Society for Testing and Materials
1916 Race St.
Philadelphia, PA 19103

CCCAM: Chairman, c/o Dept. ME, Univ. Toronto,
Toronto 5, Ontario, Canada

ICF: International Congress on Fracture
Tohoku Univ.
Sendai, Japan

IEEE: Institute of Electrical and Electronics Engineers
345 E. 47th St.
New York, NY 10017

IES: Institute of Environmental Sciences
940 E. Northwest Highway
Mt. Prospect, IL 60056

IFToMM: International Federation for Theory of Machines and Mechanisms
U.S. Council for TMM
c/o Univ. Mass., Dept. ME
Amherst, MA 01002

INCE: Institute of Noise Control Engineering
P.O. Box 3206, Arlington Branch
Poughkeepsie, NY 12603

ISA: Instrument Society of America
400 Stanwix St.
Pittsburgh, PA 15222

ONR: Office of Naval Research
Code 40084, Dept. Navy
Arlington, VA 22217

SAE: Society of Automotive Engineers
400 Commonwealth Drive
Warrendale, PA 15096

SEE: Society of Environmental Engineers
6 Conduit St.
London W1R 9TG, UK

SESA: Society for Experimental Stress Analysis
21 Bridge Sq.
Westport, CT 06880

SNAME: Society of Naval Architects and Marine Engineers
74 Trinity Pl.
New York, NY 10006

SPE: Society of Petroleum Engineers
6200 N. Central Expressway
Dallas, TX 75206

SVIC: Shock and Vibration Information Center
Naval Research Lab., Code 5804
Washington, D.C. 20375

URSI-USNC: International Union of Radio Science - U.S. National Committee
c/o MIT Lincoln Lab.
Lexington, MA 02173

PUBLICATION POLICY

Unsolicited articles are accepted for publication in the Shock and Vibration Digest. Feature articles should be tutorials and/or reviews of areas of interest to shock and vibration engineers. Literature review articles should provide a subjective critique/summary of papers, patents, proceedings, and reports of a pertinent topic in the shock and vibration field. A literature review should stress important recent technology. Only pertinent literature should be cited. Illustrations are encouraged. Detailed mathematical derivations are discouraged; rather, simple formulas representing results should be used. When complex formulas cannot be avoided, a functional form should be used so that readers will understand the interaction between parameters and variables.

Manuscripts must be typed (double-spaced) and figures attached. It is strongly recommended that line figures be rendered in ink or heavy pencil and neatly labeled. Photographs must be unscreened glossy black and white prints. The format for references shown in DIGEST articles is to be followed.

Manuscripts must begin with a brief abstract, or summary. Only material referred to in the text should be included in the list of References at the end of the article. References should be cited in text by consecutive numbers in brackets, as in the example below.

> Unfortunately, such information is often unreliable, particularly statistical data pertinent to a reliability assessment, as has been previously noted [1].
>
> Critical and certain related excitations were first applied to the problem of assessing system reliability almost a decade ago [2]. Since then, the variations that have been developed and the practical applications that have been explored [3-7] indicate that . . .

The format and style for the list of References at the end of the article are as follows:

- each citation number as it appears in text (not in alphabetical order)
- last name of author/editor followed by initials or first name
- titles of articles within quotations, titles of books underlined
- abbreviated title of journal in which article was published (see Periodicals Scanned list in January, June, and December issues)
- volume, number or issue, and pages for journals; publisher for books
- year of publication in parentheses

A sample reference list is given below.

1. Platzer, M.F., "Transonic Blade Flutter - A Survey," Shock Vib. Dig., 7, pp 97-106 (July 1975).

2. Bisplinghoff, R.L., Ashley, H., and Halfman, R.L., Aeroelasticity, Addison-Wesley (1955).

3. Jones, W.P., (Ed.), "Manual on Aeroelasticity," Part II, Aerodynamic Aspects, Advisory Group Aeronaut. Res. Devel. (1962).

4. Lin, C.C., Reissner, E., and Tsien, H., "On Two-Dimensional Nonsteady Motion of a Slender Body in a Compressible Fluid," J. Math. Phys., 27 (3), pp 220-231 (1948).

5. Landahl, M., Unsteady Transonic Flow, Pergamon Press (1961).

6. Miles, J.W., "The Compressible Flow Past an Oscillating Airfoil in a Wind Tunnel," J. Aeronaut. Sci., 23 (7), pp 671-678 (1956).

7. Lane, F., "Supersonic Flow Past an Oscillating Cascade with Supersonic Leading Edge Locus," J. Aeronaut. Sci., 24 (1), pp 65-66 (1957).

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